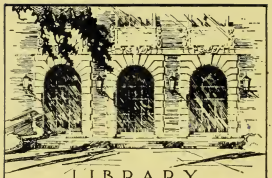

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The Right Honourable

SIR JOHN SINCLAIR, BART.

Founder of the Board of Agriculture.

Engraved by Wm. Bond, from a Miniature painted by A. Robertson, Esq.

Published Sept.r 1.st 1817, by Sherwood, Neely, & Jones, Paternoster Row

THE

CODE

OF

AGRICULTURE;

INCLUDING

OBSERVATIONS ON GARDENS, ORCHARDS, WOODS, AND PLANTATIONS.

BY

THE RIGHT HONOURABLE

SIR JOHN SINCLAIR, BART.

FOUNDER OF THE BOARD OF AGRICULTURE.

Omnium rerum ex quibus aliquid acquiritur, nihil est Agricultura melius, nihil uberius, nihil dulcius, nihil homine libero dignius.

CICERO DE OFFIC. 1, c. 42.

THIRD EDITION,

ENRICHED BY THE REMARKS, OF A NUMBER OF THE ABLEST PRACTICAL FARMERS, IN ENGLAND, SCOTLAND, AND IRELAND.

LONDON:

PRINTED FOR SHERWOOD, NEELY, AND JONES, PATERNOSTER-ROW; ARCHIBALD CONSTABLE AND CO. EDINBURGH; M. KEENE, DUBLIN; TODD, YORK; AND BARRETT AND SON, BATH.

1821.

B. M'Millan, Printer,
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CODE OF AGRICULTURE.

INTRODUCTION TO THE FIRST EDITION,

AND

PLAN OF THE WORK.

AGRICULTURE, or, "*The art of improving and cultivating the* SOIL," was formerly involved in much doubt and mystery. Those who practised it, generally followed the customs of their forefathers, without inquiring into the circumstances which led to their adoption, or justified their continuance; while such individuals as endeavoured to explain the principles of the art, were either unacquainted with its theory, or seldom had the advantages of experience. From the numerous improvements, however, which have recently been made;—from the minute and extensive inquiries which have lately been carried on;—and from the great increase of knowledge which has of late years been acquired in that art, the difficulties attending the practice of an improved System of Husbandry, have in a great degree been removed, and its principles have now become so much simplified, and are so well understood, that the time has arrived, when it is practicable, with peculiar advantages, to undertake, the arduous task of drawing up,

"A CODE OF AGRICULTURE."

Before the present period, this attempt could not have been made with any well-founded hopes of success. For so many able and well-informed indi-

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viduals, had, never, in any former era, directed their attention to agricultural pursuits;—so much capital had never previously been employed in the cultivation of the soil;—so many Practical Farmers, had never before published the result of their experience, and observations on agricultural subjects;—nor had those minute operations, on the due execution of which the success of the Farmer, in a great measure depends, been ever so distinctly pointed out.—Hence the superiority of the present period for such an undertaking.

But if such a Work may now be attempted, it is, in a peculiar manner, incumbent on the person, who ventures to lay before the Public the result of the labours of so many able men, to shew, by what means such an undertaking may be accomplished. On his suggestion, the Government of Great Britain, established a Board of Agriculture, and Internal Improvement. Under its auspices, the greatest exertions were made to collect useful information, on every subject connected with the objects of the new Institution; and thus a great body of valuable materials was amassed*, and in some degree arranged. In such a situation, it was natural for that individual, who had taken the most active concern in forming and directing the progress of the Board, to attempt reducing the substance of the whole, into so moderate a compass, that it would require, neither much expence to purchase the work,

* For that purpose, the Agricultural as well as the Political circumstances of every district in the kindom, were separately, and repeatedly examined, and Reports published, of the state of the several Counties of England, in 47 volumes, octavo, and of Scotland, in 30 volumes more. Seven volumes of Communications, in quarto, and several other works on specific subjects, have also been published by the Board. The whole was intended as the foundation of such a Work as the one now proposed, which, from the commencement of the new Institution, was in the Author's contemplation.

nor much time to peruse it. How far that has been accomplished, the reader will have it in his power to judge, by a perusal of this publication.

But to enable any person to undertake, such a task as the present, it was not only sufficient, that he had access to Books, however numerous, or however valuable the information they might contain. It was necessary for him also, to converse with Farmers ;—to discuss the various subjects connected with Agriculture, with practical men;—to survey their farms ;—to examine their various practices on the spot;—to compare the systems of different countries ;—and, above all, to be himself a Farmer, and that on a great scale. These requisites have not been wanting on the present occasion.

After considering deliberately, how the proposed plan could best be executed, the following appeared to him, the most simple, and the most comprehensive that he could devise.

I. To consider those "*Preliminary Points,*" which a Farmer ought to ascertain, before he undertakes to occupy any extent of land, as—The Climate ;—Soil ;—Subsoil ;—Elevation ;—Aspect ;— Situation ;— Size ;—Tenure, whether in property, or on lease ;—Rent ;—and other burdens affecting the farm.

II. To inquire into "*The Means which are the most essential to ensure the Success of a Farmer ;*" namely, Capital ;—Regular Accounts ;—Arrangement of Agricultural Labour ;—Farm Servants ;—Labourers in Husbandry ;—Live Stock ; — Implements ; — Agricultural Buildings ;— Command of Water ;—Divisions of Fields ;—and Farm Roads.

III. To point out "*The various Modes of Improving Land,*" by Cultivating Wastes ;—Enclosing ;—Draining ;—Manuring ;—Paring and Burning ;—Fallowing ;—Weed-

ing; — Irrigating; — Flooding; —Warping; — and Embanking.

IV. To explain "*The various Modes of occupying Land,*" in Arable Culture;—Grass;—Gardens and Orchards;—Woods and Plantations;—and

V. To offer some general remarks, on "*The Means of Improving a Country:*" By diffusing Information;—By removing Obstacles to Improvement; and,—By positive Encouragement.

In the body of the Work, general principles can alone be dwelt upon: where particular information is necessary, it will be inserted in notes; and some points, which require minute details, shall be considered in separate papers in an Appendix.

It is only necessary to add, that in drawing up this Work, having utility, rather than any claim to originality in view, the Author has availed himself, in addition to the publications of the Board, of whatever useful information he could find, in preceding writers on Agriculture, of acknowledged merit and authority; and has not hesitated to adopt their language and modes of expression, where they were distinguished for perspicuity or precision.

JOHN SINCLAIR.

Ormly Lodge, Ham-Common,
September, 1817.

ADVERTISEMENT

TO

THE SECOND EDITION.

In submitting this New Impression to the consideration of the Public, the Author has to return his best acknowledgments, for the important assistance he has received, from several distinguished Farmers both in England and in Scotland. He thinks it proper, in particular, to mention, Mr. Middleton, the Author of the Middlesex Report;—Mr. Brown of Markle, so well known for his able Works on Agriculture;—and the Rev. Dr. Skene Keith, who wrote the Agricultural Survey of Aberdeenshire.—With such aid, and that of other eminent Farmers, whose communications were extremely valuable, he flatters himself that the Work, which he has been anxious to render as complete as circumstances would admit of, will be productive of some important benefits to the Agriculture of the country.

J. S.

Ormly Lodge, Ham-Common,
Surrey, 31*st Oct.* 1818.

ADVERTISEMENT

TO

THE THIRD EDITION.

THE Author has now the satisfaction, of presenting to the Public, an improved Edition of "*The Code of Agriculture;*" enriched by the Remarks, of a number of the ablest Practical Farmers, in England, Scotland, and Ireland, whose obliging communications, have essentially contributed, to render this volume more complete.

It was long ago observed by Xenophon, that, "In a "highly polished community, the generality of persons "should be somewhat acquainted, with such a common "discussion, as that of husbandry." That object, it is hoped, will be greatly facilitated, by the publication of a Work like the present, which containins *a general view* of the principles of the art, and an account of its *most approved* practices. By the diffusion of knowledge regarding these important particulars, the prejudices which some unfortunately entertain, *either* against the superior importance of Agriculture, *or* the practicability of its further improvement, will be *most effectually* removed.

At all events, it is presumed, that this Work, in its present amended state, will prove, beyond the possibility of doubt, the superior advantages attending, what the Author, *(for want of a better name)*, has been induced to call, "*The Codean System of Knowledge.*"—By that term is meant the *collecting and arranging*, in *one Code*, or Volume,

the general principles of any particular branch of Literature, by which it is not only reduced at first into a moderate size, but may afterwards be re-printed, *with corrections*, at a moderate expence, when additional knowledge, of important facts is acquired, which shall render a re-publication necessary. A moment's consideration must convince every one, how much the diffusion of useful information, will thus be promoted.

In addition to a Code of Agriculture, it would certainly be desirable, to have a separate Work, "*On the Minutiæ of Farming;*" which the Author thinks might be accomplished in another volume, of a similar size. How that plan is to be effected, requires a good deal of consideration; and it seems, on the whole, to be better adapted, for the exertions of a respectable Society, than for those of a single individual. A particular branch of the subject, should be allotted to one person, the most likely to be acquainted *with its details;* and his performance should be circulated, *(in a printed form)*, for the purpose of collecting the result of the experience and observation of all the most intelligent Practical Farmers in the country.—A Work would thus be obtained, by means of which, many *useful practices* would be generally disseminated, and many *errors in husbandry* would be pointed out. Any trifling expence, which such a plan might occasion, would be most amply compensated, by the permanent advantages that would be derived from it.

JOHN SINCLAIR.

133, *George-Street, Edinburgh,*
1st January, 1821.

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CODE OF AGRICULTURE.

CHAP. I.

PRELIMINARY POINTS TO BE CONSIDERED, BEFORE A FARMER, CAN UNDERTAKE WITH PRUDENCE, THE OCCUPATION OF ANY EXTENT OF LAND.

AGRICULTURE, though in general capable of being reduced to simple principles, requires, on the whole, a greater variety of knowledge, than perhaps any other art*. In addition to the information which must be acquired by a farmer, to enable him to cultivate the soil with success, or to manage stock with profit, it is necessary for him, before he can undertake with prudence, the occupation of any extent of land, deliberately to consider the following important particulars:—The climate;—The soil;—The subsoil;—The elevation;—The aspect;—The situation;—The size;—The tenure;—The rent;—and the other burthens affecting the farm. These preliminary points, it is here proposed briefly to examine.

SECT. I.—*Climate.*

IT is much to be regretted, that sufficient attention is rarely paid by the farmer, to the nature of the climate in which his operations are carried on. Unless the system he adopts, be calculated for the weather his crops are likely to experience, every exertion will often terminate in disap-

* Agriculture, even restricted to the management of farm lands, when viewed in all its branches, and to their fullest extent, is not only the most important, and the most difficult in rural economics, but in the whole circle of human arts and sciences.—*Marshall's Rural Economy of the West of England*, vol. i. p. 56.—*Dr. Coventry's Discourses*, p. 23.

pointment. The system that is proper for warm and dry situations, is not suitable for cold and wet ones; and in a bleak and backward climate, the nature of the soil ought not only to be attended to, but the utmost care ought to be paid, to the early sowing, of the earliest varieties of seed. Even the species of stock to be bred, or kept on a farm, should in a great measure be regulated by the climate. Hence, this is a subject, which the diligent farmer will invariably study with the greatest solicitude*.

In considering the climate of a country, the following points are of peculiar importance:—Its general character, and the means of its improvement;—Its local heat;—The light it furnishes;—The quantity of its moisture;—The prevailing winds;—Its position, whether maritime or inland;—The regularity of the seasons;—The phenomena to which it is liable;—The productions best suited to it;—The expences it may occasion in cultivation;—The introduction of exotic plants, and animals from other climates; and—The means of ascertaining the real nature of a climate, since registering its variations, in the different seasons of the year, would be attended with much advantage.

1. *General Character.*—This not only depends on position, or latitude, but likewise on the elevation of a country above the level of the sea;—its general aspect;—the vicinity to mountains, forests, bogs, marshes, lakes, and seas;—the nature of the soil and subsoil, and the power which the former possesses of retaining heat and moisture;—the direction of the winds;—the length of time the sun continues above the horizon;—the difference of temperature between the day and the night;—and the extent of dry earth in its neighbourhood. The result of these particulars combined, form, what may be called, "The general character of a climate."

Some of these causes of an unfavourable climate, cannot be remedied by any human effort; in other cases, this may be effected by various modes, and by the following in particular.

Where a district is covered with wood, it is moister, and has a greater range of the thermometer between the extremes of heat and cold, than one cleared of woods, in

* Climate and soil, as Mr. Curwen justly remarks, are, *above all other considerations*, those which the farmer ought constantly to keep in view.—*Report to the Workington Society*, p. 36.—He adds, "that some practices, which completely answer in a better climate, I have found to fail most lamentably on my own farm."

the same latitude. Thick woods exclude the rays of the sun, and prevent the ground from being dried by evaporation. Hence the summers, (for at least a part of the day), are warmer, but the winters are colder. By cutting down a great part of these woods, and leaving only what is necessary for shelter, a more equal temperature may be obtained.

An immense accumulation of cold, inert, and spongy peat earth, in bogs or mosses, produce exhalations, which chill the atmosphere, greatly injure the vegetables over which they extend, and increase the bleakness of the climate in their respective neighbourhoods. They likewise occasion great humidity in the atmosphere, and too frequent falls of rain. By drainage and cultivation, these pernicious effects, are either wholly removed, or greatly mitigated.

In bleak, and comparatively barren situations, it is highly beneficial, to divide the land into small enclosures, with hedges and belts of planting, for the sake of warmth and shelter*; and if the heights of a country were likewise planted with judgment, the force of the wind would be diminished, its action divided, and the climate materially softened†; the benefit of which would be felt, not only on the hills, but also, from the shelter and additional warmth which would thus be given, on the plains below.

In low and flat situations, on the other hand, every obstruction to a free circulation of the air should be removed, by enlarging enclosures, thinning and clipping hedges, and judiciously pruning hedge-row trees. Particular attention ought likewise to be paid, to the important operations of draining the soil. By these means, the climate may be rendered more salubrious, and the fruitfulness of the earth, augmented to a degree, not otherwise to be expected‡. And,

The climate of an extensive region may be much improved, by cutting down large forests, by the draining of great lakes, by the laying dry of extensive marshes, and above all, by judicious cultivation. When the surface is broken, water subsides into the soil, instead of either resting on it, or being thrown off in torrents, which are often the source of much mischief; and if the surface is formed

* Derbyshire Report, vol. ii. p. 268; vol. iii. p. 671.
† Kincardineshire Report, p. 17; Derbyshire Report, vol. ii. p. 259.
‡ Middlesex Report, p. 16.

into ridges and furrows, the soil is not only enabled to imbibe the salutary rays of the sun, but the drainage of the soil, from superfluous water, is greatly facilitated*. These processes, therefore, have the effect, of regulating moisture, diminishing cold, and accumulating heat†. The instances which history furnishes of such improvements, conducted on an extensive scale, and attended by these advantages, are numerous, and well authenticated; and thence many countries now possess a genial climate, which, in former times, were scarcely habitable for cold‡.

2. *Heat.*—The importance of heat, as a stimulus to vegetation, cannot be doubted. It is at a certain degree of heat that vegetation commences, and it becomes nearly stationary, when the temperature falls below it. There are, comparatively speaking, but few plants calculated for very cold countries, and these are seldom valuable; whereas in warm and temperate regions, the variety is great, and their value unquestionable. Indeed, such is the effect of cold, that while the thermometer is below 40° of heat, the strongest plants become torpid, and remain in that state while it continues§. Revived by the warmth of spring, and strengthened by the heat of summer, they acquire fresh life and vigour, and are thus better enabled to withstand the rigours of the succeeding winter.

Heat is essential for bringing every plant, fruit, or species of grain, to perfection. Hence, an increased temperature, when not carried to excess, will augment the quantity of nutritive matter in a plant, or improve the quality of fruit grown under its influence. Thus English barley, *of equal weight*, is more valuable than the Scotch, because, from growing

* Communication from John Middleton, Esq.

† Wakefield's Account of Ireland, vol. i. p. 166.

‡ Robertson's History of the Atmosphere, vol. i. p. 170. Ovid takes notice of the freezing of the Euxine during winter, and it would appear, *that it was sometimes covered with ice, even in summer.* Ditto, p. 16.—That latter degree of coldness, however, has long been unknown in those parts, since they were cleared of woods. It appears from Horace, that about the year 480 from the foundation of Rome, the Tiber was frequently frozen over, and the ground was often covered with snow, during the space of forty days at a time. Polybius describes the climate of Gaul and Germany, as a perpetual winter. The climate of America has been greatly improved, since it has been cultivated. See Transactions of the American Philosophical Society, vol. i.

§ It is known, that water below 40° of heat, expands, in its progress to congelation, to 32°, and as much as to 48° of heat upwards, when it is becoming warmer. In the progress down to congelation, no vegetation can be carried on, as the water in plants, chills them in that state, and when below 32°, often kills them altogether.

in a warmer climate, and enjoying the advantage of a greater quantity of light, it is more fully ripened. It thence acquires more saccharine matter, and produces a greater quantity of spirits, or of malt liquor*.

It is also proved, by the experiments of Sir Humphry Davy, that wheat ripened in a more regular and warmer climate, contains more of that valuable article called gluten, than the same species of grain, when raised in England.

The medium or average heat of the year, is not, however, of so much importance to the growth of plants, as its duration, and its steadiness at a certain degree, during the season when the grain is ripening. This gives the uniform climates of the Continent, a great advantage over our variable seasons, in the production of the more delicate sorts of fruit; which, in this island, are often injured by the frosts in spring, and seldom ripen in a northern climate, where the greatest summer heat is both unsteady, and of short duration†.

3. *Light.*—The quantity of solar light which a climate furnishes, is likewise an important object of inquiry. Plants will grow in the dark, as in mines or cellars; but in such situations, the colour of their leaves is not vivid, and their seed is not brought to perfection. They have such an affinity to light, that if put into a dark place, they will always bend to any hole or window where light is admitted‡. Light is essential to increase the proportion of starch or farina;—to complete the formation of oils in plants;—and to give to fruits their proper colour, and flavour. It has also the effect of augmenting saccharine matter, insomuch that those sugar-canes which are exposed to the sun, have more of that important ingredient, than when they grow under a shade.

Nor ought the observation to be omitted, that darkness and light have effects directly opposite upon vegetables. Darkness favours the length of the growth, by keeping up

* Mr. Ker, an eminent brewer at Peebles, in Scotland, found, that English barley, on an average, yields fully one-fifth more of fermentable substance, from the same weight of grain, than Scotch barley.—*Peebles-shire Report*, p. 7, note.

† Ross-shire Report, p. 33.

‡ Humboldt found some plants growing in the galleries of mines, which retained their natural green appearance, though kept in places completely dark. But this was owing to the uncombined hydrogen gas, which abounded there. See Robertson's Natural History of the Atmosphere, vol. ii. p. 190. The plants called *esquisetum*, found anno 1812, in the cast-iron pipes which supplied Edinburgh with water, were likewise green.—*Communication from John Farey, Esq.*

the pliancy of their parts; light consolidates them, and stops growth, by favouring nutrition. Hence, in the northernmost regions, plants go through all their stages of growth, at a time, when the sun no longer quits the horizon; and the light, of which they thus experience the unremitting effect, hardens them, before they have time to lengthen. Their growth is therefore quick, but of short duration. They are robust, but undersized*.

4. *Moisture.*—The importance of moisture to vegetation is obvious to every one. Water constitutes a large proportion of every plant, and is the vehicle of the food of plants held in solution. Hence, without so essential an ingredient, they must either become stunted in their growth, or perish. In dry weather, when vegetation seems at a stand, no sooner do showers of rain fall, than a rapid growth, of every kind of herbage, or of corn, immediately succeeds, even on poor dry soils, where otherwise, however well manured, vegetation would make but slow progress†.

The quantity of rain that falls annually in any country, is a very inferior consideration, when compared with that of the *general and equable distribution* of that quantity, throughout the several days and months of the year. A great quantity, at the same time, is rather hurtful than beneficial; whereas those moderate, but *golden showers*, which regularly fall on a soil calculated to receive them, are real sources of fertility. It is by this that the character of a climate, whether wet or dry, is chiefly determined, and the operations of agriculture are principally influenced‡.

The utility of moisture, with a view to vegetation, is, in some respects, peculiarly remarkable. Thus in wet climates, as on the western coasts of England, Scotland, and Ireland, crops of grain and potatoes are found to exhaust the soil less than in dry situations. Oats in particular, are impoverishing in a greater degree in dry climates, than in moist ones§; and in the former, should be sown much earlier

* General View of Vegetable Nature, by Mr. C. F. Brisseau Mirbell, printed anno 1815, published in the Quarterly Journal of Science and the Arts, printed by the Royal Institution, No. III. p. 48, where Mirbell's work is with justice stated to be, the best lecture, on the subject of vegetation, that has hitherto appeared.

† Kent Report, p. 250. Hence the importance of destroying weeds, by whose roots so much valuable moisture is absorbed, (more especially in light soils), and taken from the nourishment of the crop sown or planted.

‡ General Report of Scotland, vol. iv. p. 136.

§ Sir Humphry Davy's Lectures on Agriculture, first edit. p. 164; and Statistical Account of Scotland, vol. xv. p. 82. In Norfolk, and in other

than they usually are*, that, in their early growth, they may have all the benefit of moisture. It has been remarked also, that a soil of the same species, not retentive, will be more productive in a wet climate, than in a dry one. Hence, on the western coasts of England, as in Lancashire, where the quantity of rain that falls annually, varies from forty to sixty inches, a siliceous sandy soil is much more productive, than the same species of soil in the eastern districts, where seldom more than from twenty-five to thirty-five inches of rain fall in a year. In wet climates also, even wheat and beans will require a less coherent and absorbent soil, than in drier situations†. At the same time, weather moderately dry, is the most favourable to a great produce of corn; and wheat in particular is most abundant, if no rain falls when it is in blossom‡.

The disadvantages of a wet climate to a farmer, more especially if accompanied with a retentive soil, are very great. It is calculated, that in the richest district in Scotland, the Carse of Gowrie, there are only about twenty weeks in the year fit for ploughing; whereas in several parts of England, they have thirty weeks, and in many cases more, during which this essential operation can be performed. Hence ploughing must be much more expensive in the one case than in the other.

The season of the year in which rain abounds, is likewise of much importance. An excess is prejudicial in any season, but is peculiarly so in autumn, when it often lodges the grain by its violence, or, by its long continuance, prevents the corn from being properly harvested. The hopes of the husbandman are thus blasted, and the fruits of his toil and industry are frequently diminished, and sometimes entirely lost§.

Besides rain, dews have a great effect in furnishing plants with moisture; and, indeed, without their aid, vegetation, in warm and dry climates, could not go on. Even in temperate regions, dews are beneficial. In Guernsey, on the coast of Normandy, the autumnal dews are singularly heavy,

dry soils and climates, oats cannot be sown too early; or the grain might be sown in autumn, as is practised in some parts of Ireland.

* In Ireland, they have been thence led to try the utility of autumnal sowing of oats.

† Sir H. Davy's Lectures on Agriculture, p. 164.

‡ Middlesex Report, p. 208, 215.

§ Statistical Account of Scotland, vol. xix. p. 249. In such latter case, there is often a quick vegetation in the shocks of the grain after it is cut down, or it heats in the stacks when carried into the barn-yard; and drizzling rains, during warm weather, when a crop of wheat is approaching to ripeness, is almost certain to mildew it.

so much so, that in the middle of a hot day, the dew drops are not quite exhaled from the grass. From this moisture, the after-grass receives great benefit*. Dr. Hales estimated the quantity of dew that falls in one year, at three and a half inches: Mr. Dalton at nearly five inches. In this matter, however, it is not easy to be correct.

5. *Prevailing Winds.*—These have a great influence on the character of a climate, and powerful effects on vegetation. When they pass over a large expanse of water, they are usually of a warmer or higher temperature in winter, than those which blow over high lands; more especially if such come from countries covered with snow. Hence the east and north-east winds, which have passed over the coldest regions of Europe, are much colder than the west and south-west winds, which blow over the Atlantic Ocean, and oftener occasion blights. The former are comparatively drier, unless when accompanied by those thick mists, called *haars*, arising from the copious evaporation of the German Ocean†. The latter are loaded with the vapours of the Atlantic, and often, from excess of moisture, are rendered prejudicial. The strength of the prevailing winds, or the violence with which they act, more especially during harvest, ought likewise to be considered‡. If they are very violent, they are apt to affect the crops, and of course it becomes an object, to suit the produce to them; and to form fences, enclosures, and plantations accordingly.

6. *Position, whether Maritime or Inland.*—A maritime position occasions a more equal temperature in a climate. Where a great body of land is exposed to the heating rays of the sun, the air becomes much warmer than it would if resting upon a small body of land, contiguous to, or surrounded by the ocean. On the other hand, as the sea always preserves nearly the same temperature, and, except in the most northern regions, is never frozen, it communicates warmth, in the cold seasons of the year, to the air passing over it, which had been cooled in its passage over continents covered with ice and snow§. Hence islands are more temperate than continents. It appears indeed, that

* Survey of the Norman Islands, by Thomas Quayle, Esq. p. 242.

† The German Ocean is above three degrees colder in winter, and five degrees warmer in summer, than the Atlantic. From that greater warmth, a copious evaporation takes place, which produces those thick mists (or *haars*, as they are called), which arise from the sea, and advancing upon the land, occasion colds and other disorders.—*General Report of Scotland*, vol. i. p. 42.

‡ Ross-shire Report, p. 3.

§ Forfarshire Report, p. 75.

the thermometer, has not so great a range on the sea-coast, as in the more inland parts of Great Britain, even at an elevation of 400 feet above the level of the sea*. Of the influence of proximity to the sea, many proofs might be brought forward. It is in consequence of this circumstance, that the city of Moscow, which is situated in some degree farther south than Edinburgh, experiences winters much more severe.

Another effect of a maritime position is, that strong winds which blow from the sea, are sometimes accompanied by salt spray, or vapour, which is injurious to crops of grain, and the leaves of trees†. But when it comes in moderation, those saline particles, with which the westerly winds are loaded, contribute to the verdure of the fields in pasture‡.

The nature of *the inland position* is also of much importance. The relative position of the neighbouring hills, occasioning a material difference of climate, exposing some districts to great severity of weather, and by protecting others from that disadvantage, greatly promoting their fertility.

7. *Regularity of the Seasons.*—In many countries the seasons are regular. In others, as in Great Britain, they are extremely variable, and often change, in the space of a few hours, from dry to moist, from hot to cold, from clear to cloudy, and from a pleasant serenity, to all the violence of a tempest§. But such irregularities of climate, however uncomfortable, are often favourable to vegetation, and compensated by the advantages they produce. It is not in countries where the seasons of heat and cold, wind and rain, are periodical, or where the greatest regularity of climate takes place, that mankind are the most healthy or vigorous, or the useful productions of the soil most perfect. Perhaps a sameness of climate, as well as of other things, is prejudicial rather than useful. Where a climate is inconstant, the air is refined and purified by the frequent changes it undergoes‖; and the disadvantages which originate from that source, are often counteracted, or at least essentially

* See the Tables in the East Riding Report, p. 10.

† Cornwall Report, p. 4.—"When the wind is impregnated with saline particles, occasioned by the west and south-west winds beating the salt water against the beach, all the hedges and trees on the windward side are destroyed, and, generally speaking, the foliage wears the aspect of its wintery dress."—*Sussex Report*, p. 3.

‡ Lancashire Report, p. 2.

§ Williams on the Climate of Great Britain, p. 2 and 3.

‖ Statistical Account of Scotland, vol. iii. p. 146 and 370.

mitigated, by judicious management, and persevering exertions*.

8. *Atmospherical and Natural Phenomena.*—The climate of a country is likewise affected by earthquakes;—volcanos;—violent thunder storms;—lightning;—hail storms in summer;—early frosts†;—whirlwinds and hurricanes;—water-spouts;—and by that atmospheric appearance, known under the name of the *aurora borealis*, so frequently to be seen in northern, and sometimes, even in southern regions; but these phenomena, are for the most part only occasional, sometimes prevent greater calamities‡, and in this country, are rarely attended with permanent evils.

9. *Effects of Climate on Productions.*—The size, and, in many cases, the value of the productions of a country, depend upon its climate, by whose influence their growth may either be advanced or retarded. The same species of tree, which, in a temperate climate, will rise to a great height, and swell to an immense size,—in an exposed situation, will remain small and stunted. By a favourable climate also, the most barren spots, which in a cold country must remain completely waste, in a warm one, may be rendered productive. Thus, where the climate is adapted to the culture of the vine,—rocks, which in Great Britain, and in colder countries, would in general be of little or no worth, in the southern provinces of France may yield as much in valuable produce, as the cultivated land in their neighbourhood§. The real excellence of a climate, however, depends on its yielding, in perfection and abundance, the necessaries of life, or those which constitute the principal articles of food for man, and for the domestic animals kept for his use. In this point of view, a meadow is much more productive, and in some respects more valuable than

* Fifeshire Report, p. 22.

† Autumnal frosts creep along the beds of rivers, destroying the corn in the flowering season, and blasting the stems of potatoes in low situations. Winter frosts are ultimately rather favourable to vegetation; and snow, particularly when it covers the ground for some time, and gradually melts away.

‡ For example, where the eruptions of a volcano, prevent the more fatal shocks of an earthquake. See *Woodward's Essay*, p. 3, § 13.

§ Young's Travels in France, vol. i. p. 313. At the same time, it is an undoubted fact, that in Dumbartonshire, rocks nearly bare of earth, and almost perpendicular, under oak coppice, have brought, by the sale of wood and bark, a price equal to an annual rent of from 18*s.* to 20*s.* per English acre. General Report of Scotland, vol. ii. p. 248; Stirlingshire Report, p. 212; Dumbartonshire Report, p. 156; and Derbyshire Report, vol. ii. p. 225.

either a vineyard or a grove of oranges; though the one may be situated in a cold and variable climate, and the other in a country celebrated both for its regularity and warmth of temperature*.

The very nature of the articles raised, depends upon the climate. Thus, in many elevated parts, both of England and Scotland, wheat cannot be grown to advantage, and in some of the low-lying districts of the latter, it has never been attempted†. In several of the northern counties of North Britain, it has been found necessary to sow, instead of the two-rowed barley, the inferior sort called bear, or big; and oats, from the hardy quality of the grain, are found to be a more certain and more profitable species of corn, than any other‡; while in humid districts, pease or beans cannot be safely cultivated, from the periodical wetness of the autumn. On the whole, without great attention to the nature of the climate, no profitable system can be laid down by any occupier of land§.

10. *Effects of Climate on the Expence of Cultivation.*—An inferior climate, is highly prejudicial to a farmer, in another respect, it greatly augments the expences of cultivation, because a number of horses are required for labour, during the short period of the year, when the weather will admit of it, which, at other seasons, are a useless burden upon the farm. When to this are joined an uneven surface, and an inferior quality of soil, arable land is of little value, and yields but a trifling rent||.

11. *Introduction of Exotic Plants, and Animals.*—It has been remarked, that many circumstances frequently occur, which render a greater knowledge of climate necessary, than usually falls to the share of the generality of husbandmen, even of the higher order; and this observation is peculiarly applicable, when plants, not indigenous in a country, or new breeds of animals, are introduced into it¶. Daily experience proves, that the vegetable productions of one country, and many of its animals, may be na-

* In France, meadows are higher rented, and pay heavier taxes, than vineyards; and it was well observed by an English sailor, when a Spaniard taunted him with a display of oranges, which his country produced, he said, *twice a year*—"See," (says he, holding up a great Cheshire cheese), "what my country produces *twice a day*."

† Derbyshire Report, vol. ii. p. 114. ‡ Ibid.

§ Husbandry of Scotland, vol. i. p. 151.

|| Statistical Account of Scotland, vol. iv. p. 565.

¶ Young's Annals of Agriculture, vol. xxxix. p. 487.

turalized in another; but that this can only be done successfully, by paying attention to the climate whence they were brought, and by endeavouring, either to render the one as similar to the other, as circumstances will admit of, or to counteract, by judicious management, the deficiencies of the new one.

12. *On the Means of ascertaining the Nature of a Climate.*—In this respect the farmer, in modern times, has many advantages which his predecessors wished for in vain. The progress of science has given rise to many new instruments, which ascertain natural phenomena, with a considerable degree of accuracy, instead of conjectures or systems being founded on loose or general experience. It may still be proper, to study the appearance of the Heavens, and not to despise old proverbs, which often contain much local truth*; but *the vane* now points out the quarters whence the winds blow, with all their variations;—*the barometer*†, often enables us to foretel the state of the weather that may be expected;—*the thermometer* ascertains the degree of heat; *the hygrometer*‡, the degree of moisture;—and *the pluviameter*, or rain-guage, the quantity of rain that has fallen during any given period; and by keeping exact registers of all these particulars, much useful information may be derived. The influence of different degrees of temperature and humidity, occurring at different times, may likewise be observed, by comparing the leafing, flowering, and after-progress of the most common sort of trees and plants, in different seasons, with the period when the se-

* Dr. Graham very justly remarks, that in a variable climate, every farmer should be somewhat versed in the prognostics of the weather. Long experience has given rise to a set of maxims on this subject, which are not unworthy of the attention of the physiologist, whilst they are the common guides even of the most illiterate.—*Stirlingshire Report*, p. 12.

† The weight of the atmosphere is subject to frequent variations, and the change of its density is made use of, to prognosticate the weather, by means of an instrument called the barometer. During the prevalence of easterly winds, from some unknown cause, (perhaps their greater dryness), the indications of the barometer, are not so much to be relied on, on the eastern coast of Great Britain. Nor is this instrument so useful in variable weather, as when a great change is to take place; and in the winter season, it is of little avail.—*Derbyshire Report*, vol. i. p. 98. But on the whole, the barometer furnishes the best indications of the state of the weather, of any instrument we have. At Chatsworth, since 1763, the daily quantity of rain has been carefully registered, and some curious deductions therefrom will be found in the Derbyshire Report, vol. i. p. 99.

‡ The hygrometer is made with sponges, or other materials, affected by dampness in the air, for ascertaining the degree of moisture at any particular time.

veral crops of grain are sown and reaped each year*. The farmer who thus attends to the character, the progress, and the length of the seasons†, and registers them with accuracy, elevates himself above the station of an ordinary cultivator, and the facts which it is thus in his power to furnish, may essentially promote "*The Science of Agriculture*‡."

Sect. II.—*Soil.*

The surface, or outward coating of land, usually consists of a collection of various earthy matters, in a loose and porous state, with a mixture of animal and vegetable substances, partially decomposed, together with certain saline and mineral ingredients. Where favourably combined, it is admirably calculated to afford support to plants, to enable them to fix their roots, and gradually to derive nourishment by their tubes, from the soluble and dissolved substances contained in the *soil*, (as this mixed mass is called), or passing into it§. The strata on which it is incumbent, are known under the general name of *subsoil*.

The importance of the soil has been described in various ways. By some it has been called the mother, or nurse of vegetation‖. By others it is represented as discharging functions to plants, similar to those which the stomach does to animals, in preparing their food, and fitting it for absorption by their roots. It furnishes the plant also with heat; for a well cultivated and highly manured soil,

* Derbyshire Report, vol. ii. p. 126.—Dr. Graham, of Aberfoyle, in his paper on climate (General Report of Scotland, vol. iv. p. 146, note), very justly remarks, how much it is to be regretted, that almost none of our Scottish naturalists, have thought of recording, from year to year, the *vernation*, or *foliation* of our indigenous plants. Such a register would furnish the best criterion of climate, that could possibly be conceived; and by comparing the differences of vernation in the course of a number of years, we might be enabled to make an approximation, which no other data could afford us.

† Dr. Coventry's Discourses on Agriculture, printed an. 1808, p. 29.—If it were possible, to ascertain the courses of the seasons, for a considerable number of years, it might probably lead to some discovery, whether there be any fixed law of nature, by which the revolutions of good and bad seasons are brought about.—*Clydesdale Report*, p. 10.

‡ In the Dorset Report, p. 34, there are valuable hints on the advantages that would result, by attention to the flowering of indigenous plants, and preserving registers of the variations in temperature, moisture, &c. on each kind of soil.

§ Sir Humphry Davy's Lectures on Agriculture, p. 11.

‖ Stirlingshire Report, p. 23.

is much warmer than the surrounding atmosphere*. The farmer, it is said, ought to study the relative value of the different soils, as a merchant does the worth of the several commodities he deals in†. Good soils, it has been remarked, will seldom yield a scanty produce. In short, a favourable *soil* and climate, are deservedly accounted, "*The first riches of a country*‡."

The necessity of paying attention to the nature and quality of the soil, need not therefore be dwelt upon. By ascertaining the qualities it possesses, or by removing its defects, the profits of a farmer may be greatly increased. He must, in general, regulate his measures accordingly, in regard to the rent he is to offer,—the capital he is to lay out,—the stock he is to keep,—the crops he is to raise,—and the improvements he is to execute. Indeed, such is the importance of the soil, and the necessity of adapting his system to its peculiar properties, that no general system of cultivation can be laid down, unless all the circumstances regarding the nature, and situation of the soil and subsoil, be known§; and such is the force of habit, that it rarely happens, if a farmer has been long accustomed to one species of soil, he will be equally successful in the management of another‖.

From inattention to the nature of soils, many foolish, fruitless, and expensive attempts have been made to introduce different kinds of plants, not at all suited to them; and manures have often been improperly applied. This ignorance has likewise prevented many from employing the means of improvement, though the expence was trifling, and

* Forfarshire Report, p. 55. It has been found, that according to Fahrenheit, the heat of the ground is commonly 2° or 3° higher than that of the circumambient air in warm weather, and considerably more in cold weather.

† Inverness-shire Report, p. 12.

‡ La premiere richesse d'un peuple, est son sol, et son ciel. This maxim, however, is more applicable to southern than to northern countries, for in the latter, *good culture* is essential, even with a good soil.

§ Sir Humphry Davy's Lectures, p. 163. And in this point of view, Mr. William Smith's large Map of the *Strata* of England, and the Memoir accompanying it, are particularly valuable. Also Mr. John Farey's more minute, but local observations of the strata and soils of Derbyshire.—*Report*, vol. i. p. 303, &c. &c.

‖ One of the most intelligent farmers in Norfolk, accustomed to a dry and sandy soil, was asked, What he would do with a wet or clayey one? He very candidly answered, "That he knew no more how to manage such a soil, than if he had never seen a plough." Farmers, when they change their situations, are too apt to carry along with them, that plan of management to which they have been accustomed, without considering that it may not suit their new situations.

within their reach. From ignorance also, of the means calculated for the proper cultivation of the different soils, many unsuccessful and pernicious practices have been adopted.

Soils may be considered under the following general heads:—Sand;—Gravel;—Clay;—Chalk;—Peat;—Alluvial; and,—Loam, or that species of artificial soil, into which the others are generally brought, by the effects of manure, and of earthy applications, in the course of long cultivation*. While describing each sort, we shall briefly state the modes of improving their texture;—the crops for which they are respectively calculated;—and the districts where they are cultivated with the greatest success.

1. *Sand.*—A soil that consists entirely of small grains of a hard nature, (*silex*), which neither cohere together, nor are softened by water, nor soluble in acids, though it ought not to be totally abandoned†, yet is too poor to be cultivated with advantage. It would indeed be hazardous in the extreme, from the risk of having the covering soil blown off the new-sown grain, in the spring, by high winds‡. Sandy soils, however, generally have a considerable mixture of other substances, by which their quality is greatly ameliorated.

The best mode of improving the texture of such a soil, deficient in retentive or adhesive properties, is, by a mixture of clay, marl, warp, (the sediment of navigable rivers), sea-ooze, sea-shells, peat, or vegetable earth; and it frequently happens, that under the sand itself, or in its immediate neighbourhood, the materials may be found which are requisite for its improvement§. Even light sandy soils are

* It is well observed by Dr. Coventry, (Discourses, p. 83), that in describing and classing soils, the divisions should be simple and obvious, and should have utility and practice in view, and not nice discriminations. Marshall has divided soils into *fifteen* different kinds, which can only tend to confuse the reader, by such minute distinctions.

† Where the soil is a mere blowing sand, the great object is, to prevent its doing mischief, by what are called, "*sand-floods*," or "*sand-drifts*." This can only be done, by propagating maram, or sea-bent, and other plants, which will grow in such soils, and will tend to fix them. This point is particularly attended to, by the inhabitants on the shores of the German Ocean.—*Coventry's Discourses on Agriculture*, p. 116. It has of late been much practised in Flintshire, &c. On this subject see Sir J. E. Smith's Travels on the Continent.

‡ Fife Report, p. 29.

§ The fuller's earth, sandy stratum of Surrey, Kent, Berks, Bedford, and other counties, is covered by a black blue clayey marl, and that rests upon a luminous clay; one or other of these tenacious strata, may very frequently be obtained, and either of them applied liberally to the sandy soil, will cure its defects.

thus rendered retentive of moisture and manure; and when judiciously treated, are considered to be more profitable, than the wheat and bean lands in their neighbourhood*.

In some parts of Norfolk, they have availed themselves of these auxiliaries, for improving a sandy soil, in an eminent degree: they have thus entirely changed the nature of the soil; and by the continuation of judicious management, have given a degree of fame to the husbandry of that district, far surpassing that of others naturally more fertile†.

The improvement of a sandy soil, is generally accomplished by fossil manures: but vegetable substances are likewise effectual. A top-dressing of peat has been tried for that purpose, and the experiment was attended, not only with immediate good effects, but with permanent benefit‡.

Though sandy soils are not naturally valuable, yet being easily cultivated, and well calculated for sheep, that most profitable species of stock, they are often farmed with considerable advantage. Where the land is hilly, rabbits are frequently kept, for the rabbit can easily throw down the light soil from the hole he excavates, where there is a declivity. Hence it has been remarked by some, that *loose-soiled hills*, will pay better in rabbit-warrens, than under any other mode of occupation§. Others consider planting to be a more profitable appropriation of such hills; but this is supposed to be a mistake, as shall be afterwards explained in the Section on Plantations. (Chap. IV. Sect. 4.)

Sandy soils, however, of a good quality, under a regular course of husbandry, are invaluable. They are easily worked, and at all seasons; they are cultivated at a moderate expence; are not so liable to injury from the vicissitudes of the weather; and in general they have a dry soundness, accompanied by moisture, which secures excellent crops even in the driest summers||.

The crops raised on sandy soils are numerous, such as common turnips,—potatoes,—carrots,—barley,—rye,—

* Curwen's Report, p. 14.

† Brown's Treatise on Rural Affairs, vol. i. p. 83.

‡ Sir Humphry Davy's Lectures, p. 178. On his recommendation, Sir R. W. Vaughan of Nannau, in Merionethshire, tried peat on a sandy soil, with much success.

§ Marshall's Norfolk, vol. i. p. 370; and vol. ii. p. 139. Minute 79.

|| Young's Calendar, p. 476. Communication from Edward Burroughs, Esq.

buck-wheat,—pease,—clover,—sainfoin, and other grasses. This species of soil, in general, has not strength enough for the production of Swedish turnip, beans, wheat, oats, flax, or hemp, in any degree of perfection, without much improvement in its texture, the addition of great quantities of enriching manure, and the most skilful management*.

When under a course of cultivation, it is a great advantage to sandy soils, either to fold sheep upon them, or to consume the crops of turnips upon the ground where they are raised. These practices, greatly contribute to the improvement of such soils; and they are thus enabled to produce luxurious crops of corn, not only by the dung and urine thus deposited, but by the consolidation and firmness of texture which the treading of the sheep occasions. When cultivated, manure should be frequently applied, and the vegetable matter should be less decomposed or rotted, than on other soils. Some farmers, likewise, insert, the putrescent manure they employ, at a considerable depth, (8, 10, or 12 inches), to prevent a too rapid decomposition.

The carrot husbandry, in the "Sandlings" of Suffolk, as they are called, is one of the most interesting objects to be met with in British agriculture. After defraying all expences, the profit is considerable. Some prefer to fatten bullocks with them; while others, who have the advantage of water-carriage, think it most beneficial to send their carrots to the London market. Carrots are likewise an admirable preparation for other crops†.

In Norfolk and Suffolk, it is found that poor sandy soils, not worth 5*s*. per acre for any other purpose, under sainfoin, will produce, after the first year, about two tons per acre, of excellent hay, for several years, with an after-grass, extremely valuable for weaning and keeping lambs. How much more beneficial, than any crops of grain that such soils usually yield‡!

The management of sandy land, according to the system adopted by the celebrated Duckett of Petersham and Esher,

* The best method of raising wheat on sandy lands, is on a clover ley, when the soil has got an artificial solidity of body, and is thereby rendered capable of sustaining this grain till it arrives at maturity.—*Brown's Treatise on Rural Affairs*, vol. i. p. 101. Wheat also may be successfully raised on sandy lands after turnips, eaten on the ground by sheep, which consolidates the soil.

† Suffolk Report, p. 125. ‡ Young's Calendar, p. 123.

in Surrey, has been strongly recommended by an eminent author. It was founded on three principles: 1. Ploughing very deep, by which a due degree of moisture was preserved in his light land, and the crops were flourishing in seasons of drought, which destroyed those where the ploughing had been shallow;—2. Ploughing seldom, but effectually, by a trench plough, or what he called a skim-coulter plough, with which he buried the weeds that grew on the surface: he has been known to put in seven crops with only four ploughings; and,—3. Occasionally raising a crop of turnips the same season, after a crop of wheat, or of pulse*.

In the Pays de Waes in Flanders, sand is likewise cultivated to great perfection. The soil of that district, which was originally a barren white sand, by a slow, but sure process, has at last been converted into a most fertile loam. The surface, to the depth of three or four inches, was at first alone cultivated, but the soil was gradually deepened, as it became progressively enriched; and now the ground, at the commencement of every rotation, is trenched by a *shovel*, (the soil being very loose), to the depth of from fifteen to eighteen inches, the exhausted surface is buried, and fresh earth brought up, enriched by the manure washed down to it, during the seven preceding years. It is then subjected to the following course of crops: 1. Potatoes; 2. Wheat, manured, sown in November, and carrots in February, for a second crop in the same year; 3. Flax, manured, and sown with clover-seed, for the next crop; 4. Clover; 5. Rye or wheat, with carrots for a second crop; 6. Oats after the carrots; and, 7. Buck-wheat; at the end of which period the ground is again trenched†.

The double crops raised in the sandy soils of Flanders, in the course of the same year, are attended with much advantage. The Flemish farmers thus obtain a greater quantity of manure, than they could produce under any other system, and by this are enabled to extract so much produce from soils, which were originally sterile, and which would

* See Mr. Arthur Young's Lecture on the Husbandry of Three Celebrated Farmers, (Bakewell, Arbuthnot, and Duckett), printed an. 1811, p. 29.

† Hints on the Agricultural State of the Netherlands, printed an. 1815, p. 10 and 76. Besides carrots, the Flemish farmers sow turnips after the crop is reaped, slightly ploughing the land for that purpose; also spurry, for feeding milch cows, by which excellent butter is obtained; and with their oats, they sometimes sow trefoil, or yellow clover, and get one good cutting of that crop, before it is necessary to plough the land.

soon revert to their former state of barrenness, without the greatest industry, and the most unwearied attention*.

In the management of sandy soils, three rules are to be observed: 1. Never to pick off any small stones that may be found in them, as they answer many valuable purposes: they shelter the young stalk in bad weather; they preserve moisture, and prevent the crops from being burnt up by scorching heats; they hinder the evaporation of the enriching juices; and, by these means, greatly assist the progress of vegetation†. 2. Frequently to renovate the strength of such soils, by laying them down with grass-seeds, and pasturing them for a few years, as they are so apt to be exhausted by aration, if corn crops are too frequently repeated; and, 3. When farm-yard dung is applied to this description of soil, always to give it in a state of compost, with a view of adding to the tenacity of the soil, and to prevent the manure from being dissipated in a dry season, or washed down by rain‡.

It may be added as a general maxim, that the fertility of sandy, or siliceous soils, is in proportion to the quantity of rain that falls, combined with the frequency of its recurrence. As a proof of this, in the rainy climate of Turin, the most prolific soil has from 77 to 80 per cent. of siliceous earth, and from nine to fourteen of calcareous; whereas in the neighbourhood of Paris, where there is much less rain, the silex is only in the proportion of from 26 to 50 per cent. in the most fertile parts§.

2. *Gravel.*—Gravelly soils differ materially from sandy, both in their texture, and modes of management. They are frequently composed of small soft stones, sometimes of flinty ones; but they often contain granite, limestone, and other

* See Improved Agriculture, and a Sketch of the Flemish System, by F. Vanderstraeten, Supplement, p. 25, printed by Longman and Co. an. 1816; and Hints on the Agricultural State of the Netherlands, p. 71. Radcliffe's Agriculture of Flanders, p. 39 and 49.

† Statistical Account of Scotland, vol. vii. p. 142. A proprietor who had carried the stones off a field by way of experiment, finding that it obstinately refused to yield its usual crop, discovering his error, was glad to restore what he had injudiciously taken away. Ditto.—See also Young's Norfolk, p. 11.

‡ Remark by Edward Burroughs, Esq. This rule of preserving stones, is by some extended beyond sandy soils, more especially in hot climates. Even in this country, stones are said to be of use in promoting the depth of thin soils; in rendering the texture of clays less compact, and less apt to subside; and where the soils are *puffy*, in collecting the shifting looseness of the materials.

§ Notes on the Soils of Cornwall, by John A. Paris, M. D. Printed an. 1815.

rocky substances, partially, but not very minutely decomposed. Gravel, being more porous than even sand, is generally a poor, and what is called, *a hungry soil*, more especially when the parts of which it consists, are hard in substance, and rounded in form*. Gravelly soils are easily exhausted, for the animal and vegetable matters they contain, not being thoroughly incorporated with the earthy constituent parts of the soil, (which are seldom sufficiently abundant for that purpose), are more liable to be decomposed by the action of the atmosphere, and carried off by water†.

Gravelly soils are improved by draining, where they are troubled with springs, though this rarely occurs;—by deep ploughing;—by mixing them with large quantities of clay, chalk, marl, peat, or other earth;—by frequent returns of grass crops;—by repeated applications of manure;—and by irrigation, if the water be full of sediment, and judiciously applied.

Sometimes the ground is so covered with flints and stones, that hardly any mould is to be seen. Land of this description is very troublesome to work, and is injurious to the implements of husbandry employed in the cultivation; but with proper management, it can often be rendered highly productive‡. The stones on the surface, by sheltering and keeping warm, in the cold seasons, any small quantity of soil which is amongst them; and by protecting it from the scorching influence of the sun, in the hot seasons, frequently produce abundant crops§.

The *stone-brash*, or *com-brash* soils, (as they are provincially called) of Gloucestershire, and the midland counties of England, may be included under the general head of *gravelly soils*, being so much mixed with small stones. They have frequently, however, more sand, or clay, or calcareous loam, in their composition, than gravelly soils usually

* Brown's Treatise on Rural Affairs, vol. i. p. 83; General Report of Scotland, vol. i. p. 53.

† Sir H. Davy's Lectures, p. 162.

‡ Kent Report, p. 15; Kincardineshire Report, p. 31. In Cornwall, (see Report, p. 11), Mr. James, of St. Agnes, cleared a small paddock of the quartz in it, at the expence of about 40*l.* per acre, and the experiment on the whole is said to have answered, by the sale of the stones, and the improvement of the soil. Breaking the stones of a gravelly soil by machinery, where the stones are soft, has likewise been recommended, for it is *the roundness* of the stones, which greatly contributes to render a gravelly soil so barren, from its aptitude to part with its moisture.

§ Statistical Account of Scotland, vol. iii. p. 325.

possess; and on that account, are treated of by some authors as a distinct species of soil*.

Gravelly soils, from their parting so readily with moisture, are apt *to burn*, as it is called, in dry seasons; but in wet ones, they usually produce abundant crops of barley, rye, tares, pease, oats, and even wheat. It has been found that a thin stratum of gravel, if mixed with shells, and other marine productions, possesses many advantages for cultivation, in a wet climate†.

A gravelly soil, free from stagnant water, gives such an additional warmth to the climate, that vegetation is nearly a fortnight earlier, than where other soils predominate‡. About Dartford and Blackheath, in Kent, such soils produce early green pease, winter tares, rye, autumnal pease, and occasionally wheat, in great perfection§. When barley and oats are cultivated, they should be sown *very early*, that they may have full possession of the ground before the dry season sets in‖. Gravelly soils, in a wet climate, answer well for potatoes; and indeed, in Cornwall, in a sheltered situation, with a command of sea-sand, and of sea-weed, they raise two crops of potatoes in the same year¶.

Poor gravelly soils, full of springs, and those sulphureous, are very unfriendly to vegetation; and are better calculated for wood than for arable culture**.

3. *Clay.*—A clay soil is distinguished above every other for tenacity. It feels smooth, and somewhat unctuous. If cultivated in a wet state, it sticks to the plough like mortar, and does not soon become dry. It is often, indeed, of so adhesive a nature, that it will hold water like a dish. In a dry summer, the plough turns it up in great clods, scarcely to be broken or separated by the heaviest roller. It requires, therefore, much labour to put it in a state fit for producing either corn or grass††, and it can only be cultivated, when in a particular state, and in favourable weather. Though it will yield therefore, under a proper system of management, great crops, yet being cultivated at a heavy expence, requiring stronger instruments, and stouter horses, it is seldom that much profit is obtained, unless when occu-

* See Mr. William Smith's Memoir on the Strata of England; and Rudge's Gloucestershire, p. 15.

† Dumbartonshire Report, p. 7. ‡ Berkshire Report, p. 19.

§ Kent Report, p. 17.

‖ Communications to the Board of Agriculture, vol. iii. p. 255.

¶ Cornwall Report, p. 9. ** Hertfordshire Report, p. 12.

†† Brown's Treatise on Rural Affairs, vol. i. p. 81.

pied by a judicious and attentive farmer. The very superior management of clay soils, as practised in the Lothians, is fortunately an exception to this general rule*.

The value of a clayey soil, depends materially on its having an open subsoil, which renders it more tractable and productive†. Its texture is ameliorated by a suitable mixture of common sand, sea-sand, and above all, of limestone gravel, where that can be obtained. Peat-moss also, that has for some time been dug up, and exposed to the action of the atmosphere, may be used with advantage. It is likewise necessary to enrich it with putrid and calcareous manures, in the course of its cultivation: and it may be much improved by having a considerable quantity of ashes mixed with its putrescent manures. It is this which renders clayey soils, in the neighbourhood of towns, so extremely fertile.

Under proper culture, clay soils are well calculated for growing crops of beans, wheat, oats, clover, and winter tares; but are not adapted for barley, unless immediately after a fallow; nor for potatoes, unless under very peculiar management‡. In regard to turnips, they do not usually thrive so well in clays, as in soils which are more free and open. But it is now ascertained, that the Swedish§, and above all, the yellow turnip, may be raised in them with advantage;—that the quality is superior;—that if they are taken up early, the soil is not injured;—and that there is no difficulty in preserving them. Clays become good meadow-lands, and answer well for hay, or soiling, when in grass; but from their aptitude to be poached, they are, in general, unfit to be fed by heavy cattle in wet weather. In dry seasons the after-grass may be used to feed neat cattle till October, and sheep till March‖. A stiff clay, however, when not cold or wet, with a strong marl under it, is preferred in Cheshire and Derbyshire, for the dairy¶.

* General Report of Scotland, vol. i. p. 55.

† Derbyshire Report, vol. i. p. 303.

‡ An eminent agriculturist, J. C. Curwen, Esq. of Workington-Hall, in Cumberland, raises both turnips and potatoes on a clayey soil; but he spares no pains or expence in their cultivation. They are grown in drills, the ploughing is deep, and the manure abundant. In some parts of England, cabbages are grown on clayey soils.

§ The Swedes have the great advantage, that they can be transplanted, and consequently the ground can be previously well worked. Thus also, they can be raised earlier, and sooner taken off; or they may be raised and stacked in damp weather, and carry them off when the frost sets in.

‖ Remark by Mr. Middleton; Derbyshire Report, vol. ii. p. 190.

¶ Cheshire Report, p. 170.

Ploughing previous to winter setting in, is of great use to clays, by exposing the surface to the frost, which mellows and reduces it in a manner infinitely superior to what could be accomplished by all the operations of man. In this state, the soil remains till spring seed-time, when it is either ploughed with a shallow furrow, or merely scarified, (which is the superior practice), and sown*.

The fallowing of strong clay (a subject to be afterwards more fully discussed), is by some eminent farmers deemed to be unnecessary, provided particular attention be paid to the bean crop, and to sowing early, horse-hoeing regularly, and weeding completely. Yet there are certainly many clay soils, both in England and Scotland, so tenacious and obdurate, so adhesive to every thing that comes in contact with them when wet, and assuming, when dry, such a stony hardness, that they are but ill calculated, in that stubborn state, for the purposes of vegetation†. In that case, a summer-fallow is indispensably necessary every six or eight years; both to prevent such soils contracting a most injurious sourness and adhesion from wet ploughing, and in order that, by exposure to the sun and winds, during the summer months, they may be thoroughly pulverized, and aerated, and thus by cultivation, joined to the corrective influence of the atmosphere‡, may be brought into a state, fit for bearing abundant crops of grain and grass§.

4. *Peat.*—This substance is unquestionably of vegetable origin. The difference between it and vegetable mould is this, that mould is derived from finer substances, as the leaves of the trees,—the remains of arable cultivation,—and the roots, as well as the leaves and stalks of the finer grasses, which contain a large proportion of earthy matters; whereas peat is chiefly composed of various sorts of aquatics; which, instead of rotting on, or near the surface, are gene-

* See Husbandry of Scotland, vol. i. p. 229. This is the common husbandry in the strong lands of Suffolk. Ditto, vol. ii. Appendix, p. 66. In Ireland, oats thus sown on a retentive clay, will be a fortnight earlier than that sown on a spring ploughing. Comm. from the Rev. Thomas Radcliffe.

† Middlesex Report, p. 20.

‡ Marshall's Kent, vol. i. p. 30.

§ Brown's Treatise on Rural Affairs, vol. i. p. 81 and 100; Husbandry of Scotland, vol. i. p. 239, where the subject of fallowing is discussed at large. Derbyshire Report, vol. ii. p. 102. Dr. Coventry contends, "that there are certain soils and situations, where summer-fallowing cannot be advantageously relinquished, for any other process of tillage whatsoever."—*Discourses on Agriculture*, p. 70. See also the Staffordshire Report, p. 50, where the practice of fallowing strong lands is ably defended.

rally immersed in stagnant water, and only partially decomposed. In valleys, peat-moss has often a considerable proportion of vegetable earth washed from the higher grounds.

An author who has successfully explained the nature of peat, has adopted the following classification: 1. Fibrous; 2. Compact; and, 3. Bituminous peat; 4. Peat mixed with calcareous matter; 5. With sand or clay; 6. With pyrites; and, 7. With marine salt. Each of these, he contends, differs essentially in its composition and chemical qualities; and above all, each species requires different treatment, in order to convert it, either into a soil, or into manure*.

In converting peat into earth, it is a rule, to plough or dig it in autumn, that it may be effectually exposed to the winter's frost. If this labour be not commenced at a proper season of the year, and if the peat be once hardened by the summer's sun, it is hardly possible afterwards to decompose it†.

The crops best calculated for a reclaimed peat-bog or moss, are, oats, rye, beans, potatoes, turnips, carrots, coleseed, white and red clover, and timothy. Wheat and barley have succeeded on such lands, after they have been supplied with abundance of calcareous earth; and the fiorin grass, (*agrostis stolonifera latifolia*), seems likewise to be well adapted to that description of soil, when moderately surface-drained.

The improvement of peat-bogs, and of all wet lands, must be preceded by draining; stagnant water being injurious to all the nutritive classes of plants‡. Soft black peat-earth, when drained, is often rendered productive, by the mere application of sand and clay as a top-dressing. When peat contains ferruginous salts, calcareous matter is absolutely necessary to fit it for cultivation. When mosses or bogs abound with the branches, or the roots of trees, or when the surface entirely consists of living vegetables, they must either be carried off, or burnt. In the last case, their ashes furnish ingredients calculated to improve the texture of the peat. For this soil, soap-ashes are found an excellent manure.

* Dr. Rennie's Essays on the Natural History and Origin of Peat-Moss, vol. i. Essay IX. p. 618.

† General Report of Scotland, vol. ii. p. 389; Derbyshire Report, vol. ii. p. 396.

‡ Sir H. Davy's Lectures, p. 178.

In Leicestershire, and other counties, they have great tracts of meadow land, which, in many instances, are the sites of lakes filled up, the soil of which is composed of peat and sediment; the former originally formed by aquatic vegetation, and the latter brought down by rains and streams from the upland. This forms a soil admirably calculated for grass*.

The fens in Cambridgeshire, Lincolnshire, and several other districts in England, likewise consist of peat and sediment. They are pared and burnt for cole-seed, to be fed off by sheep, which, by their manure, enrich the soil. After two crops of grain, they are sown with grass-seeds, (two bushels of rye-grass, and eight or ten pounds of white clover), and remain in grass for five, six, or seven years†; the longer the better. In the fens, beans and turnips have been cultivated, but have not been found to answer; nor can fen land be fallowed with advantage; for it does not bear much stirring. On such soils, potatoes, *and above all, carrots*, have been tried as an intervening crop, and with success.

The great object, however, is, to adopt the most proper management of fen or peaty land *for hay crops;* and here it is proper to mention a modern discovery of great moment. It is ascertained, that by suffering the second crop of grass, that might often with difficulty be converted into hay, to rot upon the ground, an immense produce of hay is ensured for the succeeding year, and that fen land may thus become a perpetual hay meadow. This important fact is corroborated by some experiments which have been tried near Oudenarde in Flanders, where the same effect has been produced, by leaving the second crop on the ground every second or third year: the grass produced the succeeding year, being of extraordinary length‡.

5. *Chalk.*—Chalky soils principally consist of calcareous matter, mixed with various other substances, in greater or lesser proportions. Where clayey or earthy substances are to be found in such soils in considerable quantities, the

* Leicestershire Report, p. 3.

† See "Essay on the Management of Fen Land," by John Wing, Esq. of Thorney Abbey, late Agent to the Duke of Bedford.

‡ Dumbartonshire Report, p. 331. See also, Hints on the Agricultural State of the Netherlands, Appendix, No. 7, p. 18. This seems to be a most extraordinary circumstance, but the facts stated in the text, are undoubted. The rotting of the second crop, evidently operates as a manure to the succeeding one.

composition is heavy and productive; where sand or gravel abounds, it is light, and rather unfertile.

The crops chiefly cultivated on chalky soils, are, pease, turnips, barley, clover, and wheat; and however much the soil is exhausted, it will produce sainfoin.

The chalky hills have seldom had proper attention paid to them. They are distant from the cattle-yards, and the roads to them lie up steep hills; consequently dung has very rarely been carried to them. The crops raised upon them, are drawn or carried into the vallies. Whether they are cultivated, or fed with sheep, they suffer in both cases: the corn is drawn from the hills to the barns in the vallies; and in a state of grass, the sheep who feed on them during the day, are folded at night in the vallies. This system of deteriorating the hills, ought to be counteracted, by cultivating green crops, and consuming them upon the land. Gluey as many of these hills now are, they may be rendered friable by animal and other manure.

The means of ameliorating the texture of chalky soils, are, either by the application of clayey and sandy loams, pure clay marl, or where the staple is deficient, by using great quantities of peat, or of water-fed earth. The chalk stratum, mostly, or perhaps generally, lies upon a thick bed of black or blue tenacious marl, of a rich quality, which ought to be dug up, and mixed with the chalk, to cure its defects, as well as to enrich it*.

The ashes of a sort of peat produced in some parts of Berkshire and Bedfordshire, of a red colour, and which abound with iron, are found to be highly beneficial to chalky soils, particularly when sown with trefoil, and other grasses: on such soils, these ashes are of use, not only for crops of barley, but likewise even of oats†.

Chalky soils are in general fitter for tillage, than for grazing; for, without the plough, the peculiar advantages derived from this soil by sainfoin, (one of the most valuable grasses we owe to the bounty of Providence), could not be obtained. The plough, however, ought not to extend to those fine chalky downs, (called ewe leases in Dorsetshire), which, by a very attentive management, during a number

* Communication from John Middleton, Esq. Clay, occasionally fit for the potteries, as well as pipes, and fire bricks, though more generally only fit for other bricks and tiles, is frequently met with incumbent on chalk, and may be used as manure to it, with much advantage.—*Ditto.*

† See Dr. Pearson's Essay on the subject; Communications to the Board of Agriculture, vol. iv. p. 321.

of years, have been brought to a considerable degree of fertility, as grazing land, and which are so useful to sheep in the winter season*.

A chalky soil that has been in tillage, permits water to pass through it so freely in winter, and is so pervious to the sun's rays in summer, that it is the work of an age to make it a good pasture of *natural grasses*, more especially when the chalk lies near the surface. Hence, in the western counties of England, several thousands of acres of this soil, though not ploughed for thirty years, have scarcely any grass of tolerable quality upon them, and are literally worth nothing†. Such soils ought to be cultivated, as a preparation for sainfoin, in the following manner: 1st year, Pare and burn for turnips, to be eaten on the land by sheep, with the aid of some fodder; 2d, Barley, to be sown very early with clover seed; 3d, Clover, eaten off by sheep; 4th, Wheat; 5th, Turnips, with manure; and, 6th, Barley with sainfoin. The corn crops must be carefully weeded, and in particular cleared of charlock. Under this system, which has been successfully practised by a celebrated Kentish farmer, (Mr. Boys of Betshanger), the produce has been great, and the ground has been laid down in the highest order with sainfoin, or any other grass calculated for this species of soil‡. By adopting this system, many thousand of acres might be improved, which are now lying in a miserable state§.

6. *Alluvial Soils.*—These are of two sorts; one derived from the sediment of fresh, and the other of salt water.

Along the sides of rivers, and other considerable streams, water-formed soils are to be met with, consisting of the decomposed matter of decayed vegetables, with the sediment of streams. They are in general deep and fertile, and not apt to be injured by rain, as they usually lie on a bed of open gravel‖. They are commonly employed as meadows,

* Communications to the Board of Agriculture, vol. iii. p. 112.

† Davis of Longleat's Essay. See Communications to the Board of Agriculture, vol. iii. p. 85.

‡ Mr. Boys of Betshanger's Essay. Communications to the Board of Agriculture, vol. iii. p. 257. Paring and burning a thin chalky soil, however strange it may seem, is justified by experience. A considerable covering of coarse worthless herbage, and mosses, accumulates by time, which is thus got rid of, and produces fertility.

§ It is only necessary to use the black subsoil of the chalk stratum as a manure to this soil, in order to secure abundant crops of corn or grass. Communication from John Middleton, Esq.

‖ Clydesdale Report, p. 23; Northamptonshire Report, p. 10; Derbyshire Report, vol. ii. p. 176.

from the hazard of crops of grain being injured, or carried off by floods, if cultivated.

Those fine alluvial soils, arising from the operations of salt-water, (called *salt-marshes* in England, *carses* in Scotland, and *polders* in Holland and Flanders), are composed of the finest parts of natural clay, washed off by running water, and deposited on flat ground, on the shores of estuaries, where they are formed by the reflux of the tide, and enriched with marine productions*. When analyzed, they often produce the same ingredients, or nearly so, as mould, with, in some cases, a mixture of calcareous earth. They generally have a rich, level surface, and being deep in the staple, they are well adapted for the culture of the most valuable crops. Hence wheat, barley, oats, and clover, are all of them productive on this species of soil; which is likewise peculiarly well calculated for beans, as the tap-root pushes vigorously through it, and finds its nourishment at a great depth. From the great mass of excellent soil, the fertility of these tracts is nearly inexhaustible; but from their low and damp situations, they are not easily managed. Lime, in considerable quantities, is found to answer well upon this species of soil.

7. *Loam.*—Where a soil is moderately cohesive, less tenacious than clay, and more so than sand, it is known by the name of *loam*†. From its frequency, there is reason to suppose that, in some cases, it might be called an original soil. At the same time, a constant course of tillage for ages, the application of fertilizing manures, and where necessary, mixing any particular substance in which the soil is deficient, (as clay with sand, or sand where clay predominates), will necessarily convert a soil thus treated into a species of loam‡.

Loams are the most desirable of all soils to occupy. They are friable;—can in general be cultivated at almost any season of the year;—are ploughed with greater facility,

* Kames's Gentleman Farmer, p. 323.

† Kirwan on Manures; Transactions of the Irish Academy, vol. v. p. 135. The sand which loam contains, *is as fine as meal*, in the proportion of 87 of sand, to 13 of clay. See Kirwan's Elements of Mineralogy, vol. i. p. 324.

‡ Ayrshire Report, p. 28, 29; Inverness-shire Report, p. 9; Kincardineshire Report, p. 28. In the valuable Report of Middlesex, p. 20, the same observation is made. Mr. Middleton there remarks, that a perfect sand, clean gravel, or pure clay, is not now, perhaps, to be found in any part of the county. By the operation of the elements, by manure and cultivation, the surface of all the lands of the county has assumed, more or less, the appearance of loam.

and less strength than clay;—bear better the vicissitudes of the seasons;—and seldom require any change in the rotation adopted. Above all, they are peculiarly well adapted for the convertible husbandry; for they can be changed, not only without injury, but generally with benefit, from grass to tillage, and from tillage to grass. They should not, however, be kept in tillage too long, nor, while they are in cultivation, should two white crops be taken in succession.

Loams are of various sorts: 1. Sandy; 2. Gravelly; 3. Clayey; 4. Calcareous; 5. Peaty; and 6. That mixture of soil known under the name of a hazel loam.

1. A sandy soil, and a sandy loam*, are easily distinguished. A sandy soil is always loose and crumbling, and never gets into a clod, even in the driest weather; whereas a sandy loam, owing to the clay that is mixed with it, retains a degree of adhesion or cloddiness, after wetness or drought, and will not suddenly crumble down, without the application of machinery for that purpose†.

A mellow, rich, crumbling, sandy loam, adhesive enough to fear no drought, and friable enough to strain off superfluous moisture, if incumbent on a sound subsoil, is the most profitable of all soils, being managed with much less expence than any other soil, and raising with advantage, every species of crop that the climate will admit of‡.

2. Gravelly loams, when warm, sound, and dry, or free from springs, are useful soils, more especially in wet seasons and climates.

3. A clayey or stiff loam, or brick earth, however poor, and cold in its original state, yet if it be well drained, according to the Essex system, and highly manured, it will yield great crops§. It is found well adapted for the dairy in Cheshire‖.

4. Calcareous loams have chalk for their basis, and are admirably calculated for the production of sainfoin.

5. Peat, in some of its varieties, may likewise be converted by culture, into a species of black soft-loam, and, in that state, it becomes highly fertile and productive.

6. A hazel loam, is a mixture of various soils, which as-

* Some Authors make a distinction between "*sandy loams*," in which the loam predominates, and "*loamy sands*," in which sand most prevails; the former as best calculated for pasturing large stock; the latter for sheep pasture.

† Brown's Treatise on Rural Affairs, vol. i. p. 82.

‡ Young's Calendar, p. 475; Young's Norfolk, p. 4.

§ Young's Calendar, p. 475. ‖ Cheshire Report, p. 170.

sumes a brownish colour, and is reckoned uncommonly fertile.

Rich loams, besides the other crops usually cultivated in this country, will produce hemp and flax in the greatest perfection and abundance; and in such loams, where the subsoil is both dry and open, lucern might be more generally grown than it is, in preference to other grasses, and would prove greatly superior in produce, to what are called permanent pastures*.

Before the subject of soil is dismissed, there are some miscellaneous particulars which merit attention; as, 1. The means of ascertaining their composition; 2. The nature of mould, so essential for their fertility; 3. Their colour; 4. The importance of cultivating good soils; 5. The necessity of keeping up their fertility; and, 6. The general principles on which their improvement may be effected.

1. That the most efficient methods for improving soils may be adopted, it is necessary that their composition should be known. A distinguished philosopher has suggested a plan for that purpose, which can easily be carried into effect, by any person at all conversant in chemical researches†. But the generality of farmers have not the means of entering into such researches; yet they are able, by observation and experience, to discover the most important deficiencies of the soil they cultivate. This may be effected, by comparing their own soils with each other, and with the most fertile in their immediate neighbourhood. The great object they ought to keep in view is, to render a soil capable of receiving, and retaining such a due quantity of moisture, as may be sufficient to nourish the vegetables that grow in it, and to transmit, or to throw off, such superfluous water as would prove injurious‡.

2. Mould principally arises, from the decomposition of the roots, and leaves of vegetables on grass land, and the stubble, and roots of grain crops, on arable§. It is an essential ingredient in all fertile soils, and is of great use, by attracting and retaining, a due proportion of moisture, in the mixed mass which the soil contains. Its formation on grass lands is extremely slow; for it is calculated, that it

* The conversion of permanent pastures, to crops of lucern, where the soil and climate is favourable, cannot be too strongly recommended.

† Sir Humphry Davy's Essay. Communications to the Board of Agriculture, vol. iv. p. 314.

‡ Stirlingshire Report, p. 23.—This may, in a great measure, be effected by deep ploughing and good cultivation.—*Remark by Edward Burroughs, Esq.*

§ Kirwan's Elements of Mineralogy, vol. i. p. 324.

proceeds at the rate of only one inch in a century*. Considerable accumulations of mould, however, are produced from the leaves of trees, amassed for a number of years, and rotted on the surface†. When, in addition to vegetable, there are animal remains, in a state of decomposition, the soil is distinguished for its fertility.

3. It is of essential consequence, when the surface is bare, and exposed to the rays of the sun, that the colour of the soil should be such, as to attract and absorb the greatest heat from the sun and the atmosphere, more especially in spring.

Soils are of various colours. The principal are white, black, and red. Uniformity of colour, is always a more favourable indication of fertility, than when they are *mottled*, which is generally owing to an inferior subsoil. The soil of the Carse of Gowrie, in Scotland, so celebrated for its fertility, is however of a pale colour, from a white clay which forms its subsoil.

White stiff clays are heated with difficulty, and being usually very moist, they retain their heat only for a short time.

A black soil, containing much vegetable matter, is most easily heated by the sun and air. Its temperature has increased from 65° to 88° by exposure to sunshine for an hour. A chalky soil, under the same circumstances, was heated only to 69°. In the shade, however, the black mould lost its heat more rapidly‡.

The red colour in soils, is owing to iron in various combinations. It is favourable or adverse to fertility, according to the nature of the combination. That which approaches nearest to the metallic state, is considered by some the most favourable§. Red soils are greatly improved by calcareous manures, as the chalky are by ashes containing a considerable proportion of iron.

4. It has been justly remarked, that too much can hardly be paid for a good soil, and that even a low rent will not make a poor one profitable. The labour of cultivating a rich and a poor soil, is nearly the same; while the latter requires more manure, and consequently is more expensive. Poor soils, at the same time, may have such a command

* Communications to the Board of Agriculture, vol. iii. p. 117, note.

† Hints on the Agricultural State of the Netherlands, p. 72; Derbyshire Report, vol. ii. p. 268.

‡ Sir Humphry Davy's Lectures, p. 156.

§ Clydesdale Report, p. 32, note.

of lasting manures, as lime or marl, or even of temporary sorts, like sea-weed, or the refuse of fish, as may render them profitable to cultivate*.

5. It is a wise maxim in husbandry, that the soil, like the cattle by whom it is cultivated, should always be kept up in good condition, and never suffered to fall below the work it may be expected to perform†.

6. There are various modes of improving soils.

Soils with acids, or salts of iron, may be ameliorated by the application of lime, or chalk. The sulphate of iron is thus converted into a manure.

If there be an excess of calcareous matter in the soil, as in chalky soils, it may be improved by the application of sand or clay, or earthy substances.

Soils too abundant in sand, are benefited by the use of clay, or marl, or vegetable matter.

A deficiency of vegetable or animal matter, must be supplied by manure.

An excess of vegetable matter is to be removed by burning, or to be remedied by the application of earthy materials. The substances necessary for improving soils, are seldom far distant‡. Coarse sand is often found immediately upon chalk, and perhaps always under it; while beds of sand and gravel, are commonly below clay, and clay and marl generally below sand.

The labour and expence of improving the texture or constitution of the soil, it has been justly observed, are amply repaid, by the great and permanent advantages they produce. Less manure is afterwards required;—the crops cultivated, are more independent of particular seasons;—while the capital, thus expended, secures the future fertility, and consequently the value of the land§.

* Young's Calendar, p. 474.

† Curwen's Report, p. 16.

‡ A great proportion of Ireland has, for its subsoil *limestone gravel.* In Connaught, this valuable substance lies immediately under the surface, and a sufficient quantity to manure a plantation acre, costs only 40*s*. When spread upon old grass land, it will yield two crops of potatoes, and ten or twelve of corn, without any other manure.—*Communication from the Rev. Thomas Radcliffe.*—The fens of Cambridgeshire, on the other hand, are unfortunately at a great distance from lime.

§ Sir Humphry Davy's Lectures, p. 178.

Sect. III.—*Subsoil**.

The value of a soil depends much upon the nature of the subsoil, or under-stratum. On various accounts its properties merit particular attention. By examining the subsoil, information may be obtained in regard to the soil itself; for the materials of the latter, are often similar to those which enter largely into the composition of the former, though the substances in the soil are necessarily altered, by various mixtures, in the course of cultivation.—The subsoil may be of use to the soil, by supplying its deficiencies, and correcting its defects†.—The hazard and expence of cultivating the surface, are often considerably augmented by defects in the under-stratum, but which, in some cases, may be remedied‡. Disorders in the roots of plants are generally owing to a wet or noxious subsoil.

Subsoils are, 1. Retentive; or, 2. Porous.

1. Retentive subsoils consist of clay, or marl, or of stone beds of various kinds.

A retentive, clayey, or *tilly*§ subsoil, is in general, found to be highly injurious. The surface soil is soaked with water, is ploughed with difficulty, and is usually in a bad condition for the exertion of its vegetative powers, until the cold sluggish moisture of the winter be exhaled. By the water being retained in the upper soil, the putrefactive process is interrupted, and manures are restrained from operating, consequently the plants make but little progress. Hence, its grain is of inferior quality, and when in grass, its herbage is coarse‖.

A clayey subsoil, however, may sometimes be of material

* On this important subject, see Mr. William Smith's Memoir, and Map of the Strata, before referred to.

† Thus a peaty soil is improved, when properly blended with a clayey subsoil, either by ploughing or trenching.—*Remark by Edward Burroughs, Esq.*

‡ See Brown's Treatise on Rural Affairs, vol. i. p. 77; and Dr. Coventry's Discourses on Agriculture, p. 34.

§ *Till* is a Scotch expression, implying, as a subsoil, a mixture of clay and sand, and of usually small stones, devoid of vegetable matter, and impervious to water. It is generally of a yellow colour, indicating iron, and hence is called "ferruginous schistus." In Ireland, this description of soil is called "*lackleagh.*" It is there considered to be the most effectual mode of improvement, to break through the retentive stratum, by a plough of an immense size and weight, called the *miner*, without a mould-board, drawn by eight oxen, followed, in the furrow formed by a four-horse plough. This substance, once severed, never re-unites.—*Communication from the Rev. Thomas Radcliffe.*

‖ Clydesdale Report, p. 9, and 32; Dumfries-shire Report, p. 18.

advantage to a sandy soil, by retaining moisture in such a manner, as to supply what is lost by evaporation, and the consumption of plants*. Alluvial subsoils are those which can be raised and mixed with the soil, to the greatest advantage.

When soils are immediately situated upon a bed of impervious rock or stone, they are much sooner rendered dry by evaporation, than where the subsoil is clay or marl. A stony subsoil, when in a position approaching to the horizontal, is in general prejudicial, and, if the surface soil be thin, usually occasions barrenness; unless the rock should be limestone, and then the soil, though thin, can easily be converted into healthy pastures, and, in favourable seasons, will feed a heavy stock. They will also produce good crops of corn, though subject to the wire-worm†.

2. A porous subsoil, is uniformly attended with this advantage, that by its means, all superfluous moisture may be absorbed‡. In regard to its admitting the fibrous roots of vegetables to extend deeper in search of moisture, or nutriment, that is often pernicious rather than otherwise, and must be checked by the useful operation of treading.

Below clay, and all the variety of loams, an open subsoil is particularly desirable. It is favourable to all the operations of husbandry; it tends to correct the imperfections of too great a degree of absorbent power in the soil above;—it promotes the beneficial effects of manures;—it contributes to the preservation and growth of the seeds;—and ensures the future prosperity of the plants§. Hence it is, that a thinner soil, with a favourable subsoil, will produce better crops, than a more fertile one, incumbent on wet clay, or on cold and non-absorbent rock.

Lands whose substratum consists of clean gravel, or sand, can bear little sun, owing to their not having the capacity of retaining moisture, and their generally possessing only a shallow surface of vegetable mould. In England, this soil was formerly called *rye-land*, being more generally cropped with that species of grain, than any other. When such soils are cultivated for barley, they should be sown *early and thick*, with seed soaked forty-eight hours in water, or

* Sir H. Davy's Lectures, p. 162.

† General Report of Scotland, vol. i. p. 61.—Remark by Edward Burroughs, Esq. The ravages of the wire-worm can easily be obviated. See Sect. on the Rotation of Crops.

‡ Northamptonshire Report, p. 13.

§ General Report of Scotland, vol. i. p. 60.

in the exudation from a dung heap. Thus its simultaneous germination, and ripening at the same time, *may be secured**.

On the whole, there is a most intimate connexion between the soil and subsoil; and the fertility of the former essentially depends on the quality of the latter. It is indeed evident, that the nature of the subsoil, as well as of the soil, must be ascertained, before a farmer can, with propriety, select his plants, determine on the species of manure to be employed, or arrange his course of cultivation†. Such investigations, therefore, are of the highest importance to agricultural economy. They may be the means of explaining peculiarities and anomalies, which cannot at present be accounted for, and they may suggest the best methods of improving a soil, by correcting the defects in its constitution, and removing the causes of its sterility. An enquiry, conducted on a great scale, and aided by the public, might thus lay a *basis of general improvement*, incomparably superior to any that has hitherto been attempted‡.

Sect. IV.—*Elevation.*

The value of a farm must likewise depend upon *its elevation.* Where the ground is highly situated, it must be more difficult and expensive to convey manure, and to carry on the other operations of husbandry. Land also in the same parallel of latitude, other circumstances being nearly similar, is always more valuable, in proportion to the comparative lowness of its situation, in consequence of the superior quality of its produce. In the higher districts, the herbage is less succulent and nourishing, and the re-production slower, when the land is in grass; while the grain is less plump, runs more to straw, is less perfectly ripened, and the harvest is also later, when the produce is corn§.

* Williams on Climate, p. 227,—It has, however, been asserted, that though *steeping* accelerates germination, it produces weaker plants; and that the same end may be attained by early sowing, or putting the seed in with the drills, by which it is properly covered, and moisture is secured.

† General Report of Scotland, vol. i. p. 60.

‡ General Report of Scotland, vol. v. p. 63; and Dr. Paris's Notes on the Soil of Cornwall, p. 6.

§ Clydesdale Report, p. 32. This remark is not applicable to tropical regions.

It has been calculated, that in Great Britain, *sixty yards of elevation* in the land, *are equal to a degree of latitude;* or, in other words, that sixty yards perpendicularly higher, are, in respect of climate, equal to a degree more to the north*.

Many extensive countries have no perceptible rise. These have their advantages, from uniformity of soil, where it is rich. In other districts, the surface is of a waving description; an inequality which contributes much to the ornament of the country, by the agreeable relief which the eye constantly meets with, in the change of objects, while the universal declivity which prevails more or less in every field, is favourable to the culture of the land, by allowing a ready descent to any water with which the surface may be encumbered†. Abrupt elevations, however, very much increase the labour and expence of cultivation; and the soil, in the highest parts of the field, becomes shallower, by every operation of tillage.

In regard to hilly countries, they have many disadvantages. On their sloping sides, the finer parts of the clay and mould are washed away, while the sand and gravel remain. Hence the soil in such districts, often wants a proper degree of tenacity for supporting corn crops‡. A great part of the manure that is applied, in such situations, is likewise soon lost. From various causes, also, they are colder than the plains. They are more distant from the heat of the great mass of the earth, and in a manner cut off from its influence. The atmosphere around them is liable to be often set in motion; and thus any heat which may occasionally be accumulated, is rapidly carried away. The attraction of moisture by high grounds, is another cause of their being colder.

In considering the crops to be raised in any particular farm, attention ought therefore to be paid, to its height above the level of the sea, as well as to its latitude. In latitude 54° and 55°, an elevation of 500 feet above that level, is the greatest height at which *wheat* can be cultivated, with any probable chance of profit; and even there, the grain will prove very light, and will often be a

* Worcestershire Report, p. 4. This calculation does not apply to other countries; and in fact the degree of heat depends, not only upon latitude, but upon the position of the land, whether horizontal, or lying to the south or north; also upon the angle at which the land is elevated, on either of these directions.

† Mid-Lothian Report, p. 24. See also Northamptonshire Report, p. 8.

‡ Argyllshire Report, p. 8.

month later in ripening, than if sown at the foot of the hills. Between 600 and 800 feet, may be reckoned the usual maximum of elevation, for the more common sorts of grain, and in backward seasons, the produce will be of small value, and sometimes will yield nothing but straw*. It is proper, at the same time, to remark, that in the second class of mountains in the county of Wicklow, in Ireland, where no other grain is considered to be a safe crop, rye is cultivated with success†.

Where the soil is calcareous, however, as on the Gloucestershire, and Yorkshire Wolds, from the superior warmth of that species of soil, compared to cold clays or peat, barley grows in great perfection, at an elevation of 800 feet above the level of the sea‡. Some experiments have been made to raise corn crops at even a higher elevation, on the celebrated mountain Skiddaw, in Cumberland, but unsuccessfully.

In the more remote parts of Scotland, the greatest height at which corn will grow, *so as to yield any profit to the husbandman,* is stated to be at 500 feet above the level of the sea§. At the same time corn has been produced, in other districts of that country, at still higher elevations, in particular at the following places :

	Feet above the level of the Sea.
Parish of Hume, in Roxburghshire, ...	600
Upper Ward of Lanarkshire, ...	760
Doubruch, in Braemar, Aberdeenshire, ...	1294
Lead-hills, in Lanarkshire, ...	1564‖

These, and other instances of land being cultivated on high elevations, however, are merely small spots, richly manured, and, after all, producing nothing but crops of inferior barley and oats, and seldom fully ripe, or successfully harvested. It is only where the soil is sandy or gravelly, that corn will at all answer in Scotland, on such elevated situations; and even then, only when the seasons are propitious, and when there are local advantages, favourable to warmth and shelter, in the situation of the lands.

* North Riding Report, p. 4 ; Derbyshire Report, vol. ii. p. 114.
† Communication from the Rev. Thomas Radcliffe.
‡ East Riding Report, p. 3.
§ Ross-shire Report, p. 36.
‖ General Report of Scotland, vol. iv. p. 130.

Sect. V.—*Aspect, or Exposure.*

In hilly or mountainous districts, this is an important subject of attention to the farmer; more especially where the climate is unfavourable. It is proved in a variety of instances, both in the Central Highlands of Scotland, and in other parts of the kingdom*, that where the aspect of a hill is towards the north, the soil is more fertile, than when it lies with a southern exposure. This is attributed to the variations from frost to thaw in the spring months, which are greater in a southern, than a northern aspect. Hence, while the soil to the north remains locked fast, and secured from waste, the other is loosened by the sun, and carried off by showers falling in the intervals of thaw. Soils also which face the south, are more liable to have their substance carried away by heavy rains, which are generally impelled from the south and south-west†.

But though the soil to the north often produces the heaviest crops of grass and hay, yet from possessing a more genial climate, and from the earlier and more powerful action of the sun, both corn and grass are harvested earlier on land which has a southern, than on that which has a northern aspect‡; and superiority of quality, thus compensates for any inferiority in the quantity of the produce.

Sect. VI.—*Situation.*

The system of farming to be adopted on any particular farm, and the expence attending it, must likewise depend on its situation: 1. In regard to markets; 2. To the facility with which its produce can be conveyed, where a contiguous market is wanting; 3. To vicinity to manure; and, 4. To fuel§.

1. The advantages resulting from a vicinity to a market, or to a large town, by which that is insured, are very great.

* See Aberdeenshire Report, p. 52; Ross-shire Report, p. 37; Mid-Lothian Report, p. 23.

† Marshall's General View of the Agriculture of the Central Highlands of Scotland, p. 13; Aberdeenshire Report, p. 52. See also Dr. Home on Vegetation.

‡ Kincardineshire Report, p. 17; Dumfries-shire, p. 13; Forfarshire, p. 75; and Staffordshire, p. 10.

§ The advantages of vicinity to water, shall be afterwards discussed. See Part II. Sect. 8.

Some crops, as those of potatoes, turnips and clover, are frequently sold *on the ground*, without any further trouble or expence to the farmer; and great quantities of manure may be purchased at a moderate expence. In such situations also, there is a ready sale for every article the farm can produce; and the articles sold, are not only brought to market at a small expence, but the payment is immediate*. For all these reasons it is contended, and apparently with justice, that the neighbourhood of a capital, is the most profitable spot to farm in, notwithstanding the high rent of land, and the great expence of labour†.

Where markets are not at hand, the farmer ought to take into consideration, what articles will best suit those at a distance, to which his produce must be sent. In such a situation, unless there are facilities for the conveyance of so bulky an article as corn, by good roads, or by water-carriage, it is advisable, instead of cultivating grain, to attend either to the dairy husbandry, or to the breeding of stock, which can be fattened in other districts where good markets are more numerous. This plan, by which the dairy, the breeding, and the fattening of stock, are made distinct professions, is highly beneficial to the country at large. Stock can be reared cheaper in remote districts, than where land is dear, and labour high. On the other hand, the purchaser of lean stock, avoids the expence and risk of breeding great numbers of animals. His attention is not distracted by a multiplicity of objects. He can alter his system, from cattle to sheep, or from sheep to cattle, as is likely to be most profitable; his business is simplified, and the capital he lays out is speedily returned. The division of professions between breeding and feeding, (though they may be united in circumstances peculiarly favourable), is, on the whole, a most important link in the progress of agricultural prosperity‡.

2. In regard to facility of conveyance, it cannot be disputed, that the promoting of internal communication, by means of roads, bridges, iron rail-ways, canals, rivers rendered navigable, and harbours, is the most beneficial means

* Husbandry of Scotland, vol. ii. p. 132.

† Annals of Agriculture, vol. xxxix. p. 518. Herts Report, p. 29; Surrey Report, p. 113; Middlesex Report, p. 98.

‡ Husbandry of Scotland, vol. i. p. 107. This is the practice in the Lothians, where the culture of arable land is carried to much perfection. At the same time, it is the quality of the soil that principally induces a preference to tillage over grazing.

that can be adopted for the improvement of a country. It is well known, that the best cultivated districts, are those which have the advantage of possessing the greatest facility of internal communication; without which, agriculture languishes in the most fruitful districts, while, with them, the most ungrateful soil soon becomes fertile*.

3. Another object deserving consideration is, the situation of the farm in regard to manures; for an easy access to lime, chalk, marl, sea-weed, &c. is of essential advantage to cultivation. The price at which these articles can be purchased, their quality, their distance, and expence of conveyance, are likewise of importance. Farms, for example, possessing the advantage of sea-weed contiguous, and in abundance, can pay from 15 to 20 per cent. more rent, *per acre*, than otherwise could be afforded†.

4. In the cold and moist regions of Europe, vicinity to fuel, and its quality, are important considerations to the farmer. In the same county, even in England, the difference of expence is often material. In the Hebrides, from the moistness of the climate, the expence of fuel is reckoned equal to a third part of the rent of the land; and farmers who pay, in some cases, 150*l.* per annum, would give 200*l.*, if the landlord would supply them and their servants with fuel‡. Where a farmer is under the necessity of using peat, from the labour attending the cutting, spreading, drying, and conveying it from a distance, several weeks of his horses and servants are devoted to that sole purpose; and much valuable time is lost, which ought to have been employed in the cultivation of his farm. It has been well remarked, that many farmers, to save five guineas on coal, often expend twenty, in thus misapplying the labour of their horses§. Where wood is used, it occupies a great deal of ground, that might often be cultivated to advantage; and it is not of a lasting quality‖. Coal is preferable, for general purposes, to every other species of fuel; and besides its domestic application, its superiority for burning lime, that

* Memoire sur les besoins, et les ressources de l'Agriculture Française, par M. le Comte François de Neufchateau. A Paris, anno 1816.

† Husbandry of Scotland, vol. i. p. 203.

‡ General Report of Scotland, vol. iii. p. 268, where the subject of fuel is treated of more fully.

§ Aberdeenshire Report, p. 531.

‖ Wherever coal can be had, the consumption of wood diminishes. Essex Report, vol. ii. p. 381; Suffolk Report, p. 204; Derbyshire Report, vol. iii. p. 196.—In America, every fire-place requires at least ten acres.—*Madison's Address, American Farmer*, Sept. 3, 1819.

important source of fertility, is an object of great moment. The tenant, therefore, who resides in the neighbourhood of coal, more especially if limestone, or calcareous substances, are at no great distance, farms at less expence,—can afford to pay a higher rent,—and may derive more profit from the land he cultivates, than if in these respects he were differently circumstanced.

Sect. VII.—*Size.*

Among the preliminary points which demand the particular attention of any individual, about to commence the profession of agriculture, the size of the farm he proposes to occupy, is of the highest importance. If it be beyond his capital to cultivate or improve, he can derive no profit by taking it. On the other hand, a small occupation, may not be worthy of his attention.

The size of farms, in general, is a subject on which volumes have been written, and respecting which, a great diversity of opinion prevails. It is impossible to lay down any precise or universal standard, as so much depends upon the nature and situation of the country, whether uncultivated or otherwise;—the size of estates in it*;—the character, skill, and capital of the farmer;—and a variety of local circumstances. At the same time, it is necessary to discuss the relative advantages of the different sizes, that the subject may be the better understood.

Farms may be divided into three sorts: 1. Small farms under 100 acres; 2. Moderate-sized farms, from 100 to 200 acres; 3. Large farms, from 200 to 1000 acres, and upwards, of land fit for cultivation.

1. *Small Farms.*—When the object of a farmer, was merely to procure a maintenance, (and formerly it was but little more), and agriculture was not pursued, like manufactures and commerce, as a means of acquiring wealth, small farms were adequate to the purpose†. But the case is now widely different. The expence of labour is now so great, and the rent of land so high, that the profits of a small farm, are not sufficient, with the utmost frugality, or even parsimony, to maintain a family with comfort. How-

* Where estates are very small, it is impossible that many farms can be large; for a great number of proprietors, would never agree to let small portions of their little properties, to the same farmer.

† Dr. Rigby's Report, p. 92.

ever, injurious therefore it may be, to the production of a numerous and healthy population, large farms are increasing, and must increase, in order to afford their holders a subsistence; and the tenants of smaller possessions will be under the necessity of devoting themselves to other branches of industry*.

The arguments in favour of small farms are: 1. That industrious individuals, possessed of small capitals, may have an opportunity of following the profession of a farmer, to which they would do credit, but from which, unless small possessions are to be had, they would necessarily be excluded; 2. That young men may be enabled to commence farming on a moderate scale, for though possessed of capital, or regularly bred to the profession, they are so apt to fall into errors, that they ought not at first to undertake the management of too extensive a concern; 3. That in districts where the inhabitants possess but small capitals, they may not be tempted to take larger farms, than they can manage to advantage, for where farmers embark too largely, they have often gone to ruin; and, 4. That if agriculture should cease to flourish, it is more likely to find persons fit to occupy small farms, than those of larger dimensions.

It is also contended, that the stock of the small farmer is less expensively maintained;—that from the contiguity of his fields to the stable, the stack-yard, and the dunghill, he can cultivate his land cheaper;—that he makes money by the sale of a number of small articles, which the great farmer disregards, and the supply of these useful articles is thus diminished, to the inconvenience of the public†;—and that in districts, where nature has divided a landholder's property, by hills, rivers, or other natural boundaries, such detached parts of an estate, should always be let in small farms.

It is proper here to remark, that under the head of *small farms*, cannot properly be included, those portions of land, occupied by tradesmen, manufacturers, and labourers, more as a convenience, than as a means of subsistence. The advantages of such holdings, involves a question, of great extent, and of much importance, which cannot be here entered into‡.

* Statistical Account of Scotland, vol. v. p. 422.

† General Report of Scotland, Appendix, vol. iv. p. 296. Dr. Rigby's Report, p. 103.

‡ It is fully discussed, in the Husbandry of Scotland, Dissertation 1. "On the size of Farms."

2. *Moderate-sized Farms.*—These are well calculated, 1. For the dairy system; 2. For the neighbourhood of large towns; and, 3. Where capital is not abundant.

1. There are few trades, in which a small capital can be employed to greater advantage, than in a dairy farm*; yet there is no branch in agriculture, where such constant and unremitting attention is required. That is not to be expected from hired servants; but it is in the power of the wives and daughters of the farmer to perform, or at any rate to superintend, the whole concern, without whose aid it cannot be rendered productive. Nor is attention within doors sufficient; if cows are fed out of doors, they must not be compelled to travel to their pasture, far from the place where they are milked†. Moderate-sized farms, therefore, are in this respect advantageous; and are still more likely to answer, when the farmer considers his cows as his pride;—when he takes a delight in shewing his stock to his friends;—in detailing the history of their lives;—in dwelling on the condition to which he has brought them;—and in pointing out the beauties of their progeny, and the excellence of their produce‡.

2. In the neighbourhood of towns, moderate-sized farms are general. This necessarily results from the high rents paid in such situations; the shortness of the leases usually granted of land near towns; and the necessity the farmer is under, of selling, in small quantities, the articles produced on his farm. Hence it is, that in Flanders, which is full of large towns and villages, the farms are moderate in size. This is likewise of advantage to the towns, for where there are a great number of farmers, there will be more competition, lesser objects will be attended to, and the markets will be more regularly and better supplied, at least with the smaller articles.

On this subject it has been remarked, that farmers in the vicinity of large towns, resemble *retail shopkeepers*, whose attention must be directed to small objects, by which a great deal of money is got, the greater part of which would be lost, without the most unremitting attention. The farmer at a distance from markets, who cultivates on a great

* Somerset Report, p. 84. It is said that a dairy farm should not exceed 50 cows, which is as many as one family can well manage.

† It would be well worth while for the dairy farmers in England, Scotland, and Ireland, to visit the Flemish and Dutch dairies, where they might derive many useful hints, regarding the most advantageous management of that branch of husbandry.

‡ Ayrshire Report, p. 430.

scale, may be compared, on the other hand, to *a wholesale trader*, who, as his profits are less, requires a greater extent of land, for the purpose both of engaging his attention, and of enabling him to support that station of life in which he is placed. There is this difference also, between farmers in the neighbourhood of towns, and those who reside at a distance from them, that the former find it more profitable, to sell their produce, even such bulky articles as turnips, potatoes, clover, hay, and straw, than to fatten cattle for the butcher; and they are enabled to do so, without injury to their farms, as they can procure dung in return. Indeed they are commonly bound to do so by their leases, when these articles are sent to market*.

3. In all districts where capital is not abundant, moderate-sized farms ought to be preferred. The size of a farm ought always to be in proportion to the sum which the holder can afford to lay out in stocking it. This rule ought in a special manner to be observed, when the circulation of a country is reduced;—when markets are consequently low;—and when it is not easy to raise a considerable sum of money, even on good security, should an unexpected demand occur, and no sales have been made to meet it. Where such circumstances take place, a large farmer may be involved in difficulties, or reduced to ruin, which the occupier of a moderate farm, whose business is conducted on a smaller scale, may escape.

3. *Large Farms.*—Wherever agriculture is followed as a distinct profession, a farm ought to be of such a size, as to furnish regular employment, not only to the farmer himself, but also to the servants and labourers employed by him; in order that the greatest possible profit may be derived from their labour, at the least possible expence. It is evident, that this can only be accomplished on a farm of considerable extent, where judicious rotations of crops are adopted, and where the economy of the farm is so conducted, that too much work does not occur at one season of the year, and too little at another; in short, where that division of labour, from which manufacturers have derived such essential benefit, is applied to husbandry†.

The arguments which have been adduced in support of large farms, may be classed under the following heads.

1. When a farm is of a large size, less expence is incur-

* Husbandry of Scotland, vol. ii. p. 126.

† Brown's Treatise on Rural Affairs, vol. i. p. 141.

red in building houses and offices, and in keeping them in repair, than if the farm were divided, and several sets of houses, &c. were erected for the accommodation of two or more farmers*. 2. The enclosures on a large farm being on a greater scale, are originally made, and afterwards kept in repair, at a less expence; much ground is thus added to cultivation, and less shelter is given to the vermin with which hedges and walls abound. 3. There is also a saving of expence in housekeeping, when two farms are united into one, the amount of which must vary according to circumstances. 4. The saving in the expence of cultivation is considerable. When a farm of 200 English acres, is united to one of 300, the work of a pair of horses and a ploughman will be saved; fewer instruments of husbandry are also necessary; in particular, one threshing-mill may be sufficient. 5. Though there are exceptions to that rule, yet in general, from superior capital, on large farms, the land is much better cultivated, more effectually drained, and more improved by extraneous manures, which small farmers cannot afford to purchase to much extent, or to convey to any distance. 6. A much greater quantity of disposable produce is sent to market. The small farmer and his family indeed, raise so little, and consume so much of the produce of the land they occupy, that the surplus they can share, must always be trifling; and, in unfavourable seasons, none can be expected. Hence it is only by means of large farms, or a number of moderate-sized ones, that great towns or populous districts can be supplied, in sufficient quantities, with such articles of primary necessity as grain and butchers' meat. In regard to the latter in particular, it is generally sold by the large farmer, in a fattened state, which is seldom done by the small one. 7. The live stock on large farms, is confessedly of a superior quality, because a large farmer can better afford to purchase the best sorts, and to maintain them afterwards: the implements of husbandry are likewise of a more improved description, and capable of performing their work in a superior manner. 8. The labour on a large farm can be better subdivided than on a small one, by means of which, critical periods may be caught, more strength of labour can be applied to particular parts of the farm when wanted, and the work may be done bet-

* There are very few instances in Ireland, where the landlord builds either a house, or offices, for the accommodation of the tenant. It is done at the expence of the tenant, and is rarely allowed in his rent.—*Remark by Edward Burroughs, Esq.*

ter, and with more expedition, in an adverse season. 9. The large farmer has full employment, independent of manual labour. He has enough to do in superintending others, instead of working with his own hands; and if he should employ himself in doing a job at one part of his farm, he would lose more than the value of his own labour, by his servants being either idle, or ill directing their labour, in other places. From thus having full employment, he is not under the necessity of engaging in other undertakings, which not only would abstract his attention from his farm, but would often be attended with real loss. 10. A farmer with a large capital, has usually enlarged ideas, which generally expand with the extent of his possessions: he usually receives a superior education, and understands better every branch of his profession: he is able to travel about to obtain useful information, and having more enterprise, and fewer prejudices to subdue, he is more ready to adopt new improvements*. 11. On a large farm, a greater variety of practice can be introduced, such as pasturing a proportion of the farm alternately; and while the large farmer, may be both disposed and enabled to change his intended system, should an unfortunate season, or some other incident, render it necessary; the farmer on a limited scale, must continue in the trodden path, often in opposition to the true principles of his profession. 12. Large farms are favourable to the improvement of land in an inferior or waste state. The small farmer generally leaves it as he finds it; whereas, when a great farmer, with a considerable capital, gets such land into his possession, on an improving lease, he soon renders the inferior land he occupies, or even the neighbouring waste, nearly as valuable as the old cultivated soil. 13. Large farmers, when they are active, spirited, and intelligent, are the fittest persons to try experiments, and to prosecute them to the necessary extent; small farmers cannot afford it, and gentlemen farmers, (though there are exceptions to the rule), seldom give such unremitting attention, as is necessary for ensuring success. 14. Many operations on a large farm can be done better, and, in proportion to their importance, at a cheaper rate,

* There are few branches of natural philosophy, chemistry, natural history, mechanics, &c. which may not be profitably applied to a large farm. To take advantage of these, the occupier ought to be a man of education, and competent to his own progressive scientific improvement, by reading, observation, and intercourse with intelligent men. He may thus be enabled, to discover some new processes, by which his own immediate profit, and the general interest, may both be forwarded.—*Rigby's Report*, p. 88.

than on a small one. For instance, where a large flock of sheep are kept, or a number of cattle, careful and intelligent servants may be hired for attending them, which no farmer on a small scale can afford. A large farmer can also sell at market, in the same space of time, ten times the number of cattle or sheep, or ten times the quantity of grain, than any small farmer can have to dispose of; and in general, has better information regarding the state of the markets. 15. The large farmer, possessed of all these advantages, in addition to his superior capital and credit, can generally afford to pay a higher rent, with more punctuality, than the small farmer; from whom the rent he agreed to pay, cannot often be exacted without compulsion. 16. The large farmer pays more taxes to government for his house, windows, and horses, and for every article of his consumption. Indeed, small farmers whose rents were under 50*l.* a year, were considered by parliament, and justly too, to be in so humble and poor a state, that they were not made liable to the payment of the income or property tax; and if all the farms in the kingdom had been under that amount, government would not have received a single shilling from the occupiers of land, on account of that tax. 17. Large farms, in the occupation of wealthy renters, are a species of magazines or repositories, kept for the use of the public, but without any of those mischiefs which would attend them if they were a public concern*. In the last place, respectable farmers are a most important link in the great chain of society, rarely to be found in any country, Great Britain excepted;—a class of individuals, whose habits of industry, intelligence, and spirit, and the extent of whose capital, which it has required centuries to accumulate, form a species of bulwark, materially tending to preserve the existing order of society; but if that bulwark were once laid prostrate, it would baffle human policy, without the existence of similar circumstances, ever to renew it†.

On the whole, it appears, that, in an extensive tract of country, there must be, owing to a variety of circumstances, a considerable diversity in the size of farms;—at the same time, there is a regular progress in regard to their general extent.

* Gloucestershire Report, p. 54.
† Husbandry of Scotland, vol. ii. p. 150.

At first, when the art of agriculture is in its infancy, farms must be small, because there is neither capital to cultivate, nor skill to manage large occupations; nor are large farms necessary in that period of society, because it is seldom that great numbers of inhabitants are collected in towns, who must be provided with food. Besides, a feudal chieftain is desirous of increasing the number of his followers; and, for want of other sources of employment, a father has no other means of providing for his sons, when they remain at home, than by giving them a share of his farm. In the course of a few generations, therefore, a farm of even a considerable extent, is thus frittered down into very trifling possessions. Hence there is a strong tendency, in the first stages of agriculture, to have farms of a small size, and to have a number united together, under what may be called the village system.

In process of time, however, as population advances,—as capital increases,—and as skill improves, farms are enlarged; and it is found by experience, that one man can cultivate any given extent of country, (say from 300 to 500 acres), at less expence, can raise a greater produce, and can afford a higher rent, than a number of small occupiers. During this stage of the progress, farms are conjoined, and the farmer of skill and capital, not only rents tracts of country in his own immediate neighbourhood, but is also tempted to speculate even in remote occupations. Farms thus increase to a very large extent, and indeed attain a size, which, at first sight, appears calculated, (unless where it is the practice to have married servants, or the culture is of a very superior description), materially to diminish the number of persons, deriving their subsistence from the cultivation of the soil.

Two circumstances, however, afterwards take place, which have a strong tendency again to diminish the size of farms.

1. As the great inducement of any individual to enlarge, as far as he can, his concerns in agriculture, is owing to the cheapness of land, and to the profits he derives from that employment, in which he unites skill to capital; so, on the other hand, when by competition, the rent of land increases, and when, from various causes, many competitors appear, he has then no inducement to continue in the occupation of more than what he can conveniently and profitably manage. He diminishes therefore the extent of his concerns, by giving up some of his farms to

the proprietors, or establishing branches of his own family on them, or sub-letting some of them, when he is authorised so to do.

2. In the vicinity of towns, and on all lands approaching to garden culture, the occupier has so many minutiæ to attend to, that a large farm becomes unsuitable. In such situations, farms necessarily become smaller; and indeed, as the rent of land increases rapidly, a great extent of it would prove a most hazardous experiment.

That it appears, that the size of farms must depend, *on the circumstances of a country*. What is a proper size in one district, is not so in another; and what is a proper size at one time, is not so at another, even in the same district. That size, however, is always the best, whether small, or moderate, or large, for which, in the state of any district, there is the greatest demand at that time. That demand ensures the highest rent, and the highest rent will necessarily occasion, and indeed enforce, the greatest produce that can be drawn from the soil*.

Sect. VIII.—*Tenure, whether in Property or on Lease.*

In this Section it is proposed to examine the advantages and disadvantages attending the occupation of land, either by the proprietor himself, or by tenants holding under him.

1. *Proprietors occupying their own Land.*

It is certainly in various respects attended with public advantage, that a large proportion of the soil, should be the property of one class of the community, and in the occupation of another. In some of the American States, where, from a scarcity of population, leasehold tenure is hardly known, the land is often so much exhausted by the inattention of the owners, who think they may take any liberty with their own property, that in many districts the crops of wheat, do not exceed an average of seven or eight bushels per acre†. How different is the case in this country, where the owner, instead of cultivating his own fields, lets them to another? A careful landlord, indeed, considers himself as a trustee for his family, and for the public. He will not

* Husbandry of Scotland, vol. ii. p. 164; General Report of Scotland, vol. i. p. 182.

† Sir William Strickland's Observations on the United States of America, in the Communications to the Board of Agriculture, vol. ii. p. 154, 155.

suffer his fields to be exhausted, by improper management, or injudicious rotations; and when he grants a lease to a tenant, it is either to a person in whom he can safely place confidence, or under such covenants, as are the most likely to prevent that great source of public wealth, the soil of the country, from being injured by improvident management. It must be admitted, however, that such covenants are often very injudiciously drawn up.

When a tenant also, has a rent to pay to a landlord, it has a strong tendency to render him industrious. Without that spur to exertion, he would not take half the pains he usually does, to cultivate his farm, or to supply it with stock. The burden of rent is likewise attended with another advantage, for in order to be enabled to pay it, the farmer finds it necessary to supply the markets more regularly. When persons have no such stimulus, they are induced to keep up their produce, that they may enhance its value.

Besides, a tenant who cultivates the soil as a profession, has but one object in view; and he is therefore more likely to manage the concern better than a proprietor, who has often other avocations to distract his attention. Not only is the tenant necessarily more attentive to his business, but he carries it on at less expence;—his cattle and servants do more work;—the produce of his farm is more carefully looked after;—and no money is expended, without the prospect of an adequate return. Expensive improvements, such as erecting commodious buildings, making roads, enclosing, draining, irrigating, and perhaps a very great application of calcareous manures, may be advantageously executed by the landlord; but in regard to raising the products of the soil, by judicious rotations of crops, complete aration, abundant manuring, selection of the best seeds, &c. an intelligent farmer has evidently an advantage*.

As a proof of the justness of these doctrines, it is a well known fact, that small proprietors, when they are men of sense and ability, frequently let, or sell their own estates, and take the lands of others on lease; knowing well, that if they resided on their own property, they would be tempted to live like gentlemen, and to indulge in idleness and inactivity†. Instances also have not been wanting, where,

* General Report of Scotland, vol. i. p. 176.

† The Rev. Dr. Cartwright recollects a curious circumstance of a person who resided, about fifty years ago, in a village on the road between Newark upon Trent and Sleaford, who had been obliged to sell his estate, took it on

owing to negligence, or want of capital to improve it, the owner of an estate, has been obliged to sell it, and has hired the same land to farm, at a fair rent, and has done well*.

When the proprietors of considerable estates, cultivate their own land, they may have one of five objects in view: 1. Accommodation; 2. The pleasure of farming; 3. Profit; 4. To make useful experiments; and, 5. The general improvement of their property.

1. It is not only a healthy, but a most useful employment, for gentlemen residing in the country, to have some land in their own possession, for the purpose of providing themselves with various articles which their families may require. Perhaps those articles might often be purchased fully as cheap at market; and it might be more profitable to the proprietor, to let the land at a fair rent, than to occupy it himself; but the occupation of land is a source of rational amusement, and it is desirable for every proprietor residing in the country, to have a spot he can call his own, where he and family can take air and exercise. Besides, if attention to a large extent of arable land be found inconvenient, so much corn need only be raised by a landholder, as may be necessary for his own purposes, and after his fields are enclosed, and laid down to grass, he may let them to farmers or graziers, the proprietor reserving what is absolutely necessary for his own accommodation†. What the extent of such accommodation land should be, need not be here discussed; as it depends, upon the establishment kept up by the proprietor, the portion of time spent by him in the country, and the degree of superintendance that he can give to his farm.

2. When operations of agriculture were first attempted, it was for the purpose of procuring *the mere necessaries of life*, but when these were once obtained, its conveniences and comforts were next sought after, and ultimately its refine-

lease, and made as a farmer, so much money, that he was able to re-purchase it. Small proprietors in general, are seldom possessed of capital sufficient to improve their lands, and frequently indulge notions, which disqualify them from the pursuits of industry. *Dumbartonshire Report*, p. 20.—Hence, in the progress of society, this class of men gradually disappear. *Stirlingshire Report*, p. 69.—It is found more profitable, to have a capital in money, judiciously employed in farming, than a capital in land.

* Staffordshire Report, p. 30; Ayrshire Report, p. 77.

† General Report of Scotland, vol. i. p. 172; Husbandry of Scotland, vol. ii. p. 139.

ments. Hence agriculture, which originally was considered to be a rude and simple source of employment, became, in process of time, *a liberal art*, capable of contributing to improve the scenery of a rich domain, or to shelter and adorn the residence of the great and powerful*. Hence *ornamental agriculture* arose, as distinguished from the useful. The distinction between them is, in general, abundantly obvious. The scheme of culture which a gentleman may pursue in his park, or on lands near his seat of residence, is generally a very different one from that a husbandman should adopt in his fields. The principle of the former is taste, that of the latter, economy, or thrifty management; the characteristic of the former, is *ornament*, that of the latter, *utility;* and the object of the former, is *pleasure*, that of the latter, *profit*. When the latter object is pursued on an extensive scale, it becomes a serious employment, requiring constant and great attention†.

3. Though there are instances of spirit and great application, producing effects creditable to the owners of estates, who cultivate their own lands, for arable crops, yet their profit, generally speaking, is much less than if the same land were occupied by a farmer. Proprietors rarely attend to all those minutiæ which a corn farmer must not neglect. Neither do they regularly oversee their servants, examine the state of their working cattle, attend fairs and markets, nor personally superintend the progress of all their farming operations. These duties, therefore, are commonly entrusted to a bailiff, who is seldom sufficiently qualified for them all; nor does he almost ever possess so much attention and frugality, as a prudent and well-informed farmer, whose personal interest is at stake, and who manages all his transactions. Though a landed proprietor, therefore, may have acquired sufficient practical knowledge of husbandry, to superintend the management of a farm; yet his other pursuits preclude him from paying such attention to those inferior objects, without which, it is impossible that he should farm to advantage, upon a great scale. Hence a species of farming arises, which is justly denominated *profuse agriculture*, founded on unlimited expence in tillage and manuring; by which, perhaps, double crops are obtained, but are

* Cicero, in his Cato Major, has well observed, "That there cannot be a richer, or a more ornamental object, than a well-cultivated field. Agro bene culte, nil potest esse, nec usu uberius, nec specie, ornatius."

† Coventry's Discourses, p. 55.

raised at triple cost. Thus, with delusive notions of profit, many are betrayed into real, though unheeded loss. Indeed it is well known, that gentlemen cultivators, after having pursued the profession of husbandry for some years, with much ardour, have frequently relinquished it with chagrin*. Where their farming, however, is carried on with economy, and in moderation, it is of much use, keeping up a spirit of experiment in cultivation, and in particular, tending to promote the improvement in stock†.

4. It is next proper to observe, that since the attention of the public has been so much directed to agricultural pursuits, many respectable proprietors of land‡, have cultivated extensive tracts of country, with the view of trying useful experiments, and disseminating a knowledge of agriculture in their respective neighbourhoods. Nothing can be more laudable than such pursuits. The spirit of improvement which they have thus excited, and the important facts which they have established, must be in the highest degree gratifying to themselves, and useful to their country§.

5. Some landlords in remote and unimproved districts, convinced that example, and not precept, will alone dispel

* General Report of Scotland, vol. i. p. 172; Dr. Coventry's Discourses, p. 59; Kent Report, p. 50.

† Gloucestershire Report, p. 34.

‡ Among these, the Duke of Bedford, the Earl of Egremont, Lord Somerville, Sir Joseph Banks, Mr. Coke in Norfolk, Mr. Western in Essex, Mr. Curwen in Cumberland, Sir W. W. Wynne, and Sir Robert W. Vaughan in Wales, and others might be enumerated.

This has likewise been much the case in Ireland, where of late years, the landed proprietors have become agriculturists, either through necessity, (not having been able to dispose of their lands to advantage), or from having caught the patriotic spirit of improvement, so laudably set by the sister kingdom. This has been attended with many beneficial consequences to that country. Gentlemen, instead of devoting their time only to pleasure and amusement, as was formerly the case, are now proud of being considered zealous improvers on their own estates, and do not consider a knowledge of rural affairs derogatory to their condition in life.—*Remark by Edward Burroughs, Esq.*

§ Husbandry of Scotland, vol. ii. p. 140. Formerly a nobleman who directed his attention to experiments in cultivating the various and useful tribes of the vegetable kingdom, was considered by his brother peers as degrading his high station in life. But now, what a change? Every where proprietors are to be met with, who, by every means in their power, either by precept,—by example of improved culture,—by publications,—or by premiums, combat the prejudices of their uninformed tenantry, and become a blessing to their neighbourhood.—*South Wales Report*, vol. i. p. 178.—In Ireland also, many of the nobility and gentry have become intelligent farmers; but as they seldom attend to the practical part of it, they often find it difficult to prevail upon their stewards to follow any new system. It frequently happens, that a failure in this case, either through ignorance or obstinacy, prevents a repetition of the intended improvement.—*Remark by Edward Burroughs, Esq.*

ignorance, and remove prejudice in rural arts and practices*, have resolved to take a farm into their own hands, with a view of showing an example of correct husbandry to their tenantry; and they look for profit, not from the produce of the farm they occupy, but from the general improvement of their estate†. In other cases, improvements have been carried on by the proprietors on a still greater scale. When their estates have been in bad order, the farms ill arranged in regard to extent, figure, and boundaries, and the farmers dispirited, poor, and unskilled in agriculture, they have taken a considerable tract of country into their own hands, and, after improving it, have let it to enterprising and skilful farmers. They have then removed their servants, cattle, and implements of husbandry, to another part of the estate, and after treating this in the same manner, they have proceeded to others, as far as circumstances rendered it expedient‡.

It is well known, however, that proprietors have in general derived the greatest profit from farms, which they have only partially improved. Indeed it seldom happens, that a landed proprietor can thoroughly improve a farm, without incurring much unnecessary expence; whereas, when a foundation has once been laid, a judicious farmer, with more attention and economy, can accomplish the same, or nearly as much improvement, on far more moderate terms§. Nor, in economical agriculture, is any practice worthy of attention, in which the expence incurred, will not be repaid with a fair profit‖.

2. *Farmers occupying Land.*

In former times, the connexion between a landlord and his tenants, was of a military description. The proprietor

* Cornish Report, p. 17.

† Some are of opinion, that instead of this kind of experimental farming, it would be of more advantage, both to the proprietor and to the district, to encourage a farmer from another county to set the example, as farmers are, in general, more ready to imitate the practice of their equals, than that of a large proprietor, who is so far removed from their own station in society, and, as they observe, who pays no rent for his land.—*General Report of Scotland*, vol. i. p. 172.

‡ In Scotland, this plan has been frequently adopted, and with much success. The exertions of an Earl of Findlater, of a Craik of Arbigland, of a Robert Barclay of Ury, of a Henry Home Lord Kames, stand eminently conspicuous in that honourable list.

§ General Report of Scotland, vol. i. p. 173.

‖ Marshall on Landed Property, p. 224.

of an estate was himself a warrior; and those who possessed land under him, were his soldiers, who were bound to military service, and who paid him hardly any rent in money, but only some personal services, and a moderate quantity of some articles in kind, for the maintenance of his family.

When the feudal system was abolished, the landlord, at first, still considered himself as the patron of those who were placed under him. The rents continued low, the occupiers of the estate claimed, from generation to generation, under the name of "Kindly Tenants," a sort of tacit patrimonial interest in their respective possessions*; and as they paid very inadequate rents, and had no permanent security in their possessions, nothing could exceed their indolence, their ignorance, and of course the poverty of their condition.

The connexion between the two classes, is now of a description totally different. The landlord considers himself as the owner of an estate, of which he must make the most he can, for the benefit of himself and family. He lets it for a certain number of years, to persons possessed of skill, integrity, industry, and capital, under the obligation of paying him annually, a specific share of the produce, converted into money, besides being bound, if not to improve the value of the property, at least that it shall not be deteriorated during the currency of the lease. The contract becomes of course more of a mercenary nature, without, however, totally destroying ties of a more pleasing nature; for the landlord, on the one hand, must feel himself deeply interested in the success of his tenant, on which his own income and prosperity materially depend; while the tenant, on the other, looks up to his landlord as a friend, whose interests are necessarily interwoven with his own, and who will naturally be inclined, to give an industrious and improving tenant a preference, when the farm is to be re-let.

Under this system, it is essential both for the landlord and tenant, that the connexion between them should be established on just and liberal principles, so as to induce men of knowledge, enterprise, and capital, to devote their attention to the art of husbandry. That can only be expected, where leases are granted. These furnish the most beneficial species of encouragement to agricultural improvement; indeed if any great exertions are necessary, they are not to be attempted without that security†. Where a pro-

* See Aiton's Survey of Ayrshire, p. 175.
† Sussex Report, p. 43.

prietor, therefore, does not incline to occupy his land himself, he naturally resolves to surrender the temporary possession of it to others, under such conditions as may be mutually advantageous.

A lease, indeed, is properly a contract, founded on the principles of equity, between two men for their mutual advantage. The one possesses an absolute right in the property of a certain tract of land and its produce, the other purchases the temporary privilege of appropriating the produce of that land to himself, at a certain stipulated price. The proprietor of an estate, may thus be considered as in the possession of a certain fixed capital in land, which is capable of producing, when duly cultivated, a certain annual value. The cultivator of the soil, on the other hand, possesses a moveable capital, consisting of the necessary funds for stocking a farm, his knowledge in the art of agriculture, and his industry. Thus situated, the parties, like other men who wish to enter into a joint concern, are induced, by the prospect of mutual advantage, to agree to unite their capitals, for the purpose of assisting nature in producing human subsistence; and their respective interests, having been mutually considered, their agreement constitutes the terms, or specific articles of the lease. On this plain principle depends the connexion between landlord and tenant. The capital invested by the cultivator, the rent he pays, his skill and labour, the contingencies, and chance of loss that may arise, from the inclemency of the seasons, must all be compensated, by the value of the produce of the soil. Where these principles are fully understood and acted upon, both proprietor and tenant will be placed in the most favourable situation, of which the nature of the transaction admits. But where these are departed from, the interest of the one, or of the other, or perhaps of both, must suffer, in proportion to the degree of aberration from that equitable line, which so distinctly marks their respective rights and obligations*.

In regard to the manner of settling a lease;—the period of entry, and the regulations therewith connected;—the duration of leases;—and the covenants to be inserted in them, as these particulars require more detail than is consistent with the nature of a work restricted to general principles, it is proposed to discuss them in a separate paper, (see Appendix, No. I.) As to the form of a lease, and the

* General Report of Scotland, vol. i. p. 187.

stipulations essential for the interests of the two parties, these must vary so much, that it is hardly possible to reduce them to one uniform plan.

Sect. IX.—*Rent.*

The price periodically paid by the occupier, to the owner, for the use of his land, is called *rent.* It formerly consisted of a great number of particulars; as personal services, trifling sums in money, and various articles in kind, as grain, lambs, pigs, poultry, &c. In countries unprovided with a sufficient quantity of circulating medium, payments in kind were unavoidable; nothing, however, could be more injudicious, when circulation became more abundant, than such payments. The grain, and other articles of a similar nature, were uniformly of inferior quality, and the exaction of personal services, was of little advantage to the landlord, while it was an oppressive burden on the tenant, obliging him to keep a greater number of men and horses than his own farm required, and often interrupting the most important farming operations. Rent, therefore, in the present more advanced period of society, ought in general to be restricted to money payments*, and the imposing of any burden ought to be avoided, which has a tendency to impede the industry of the tenant, or to withdraw his attention from the management of the farm†.

The amount of rent, in a general point of view, must always depend on a variety of circumstances; as the wealth of the country;—its population;—the price of produce;—the amount of public and other burdens;—the distance from markets;—the means of conveyance;—the competition among farmers;—and other less important considerations;—but the rent of any particular farm must be regulated by,—The nature of the soil;—The duration of the tenure, and the covenants contained in the lease;—The capital to be invested by the farmer in its culture;—and the expences to which he is liable.

* The propriety of varying, to a certain extent, the payments in money according to the price of grain, shall be discussed in the succeeding section.

† General Report of Scotland, vol. i. p. 194; also Dumbartonshire Report, p. 48, 49, &c. In imposing such payments and services on his tenants, a landlord in fact buys the worst poultry, at the highest price, and pays for a little work, imperfectly executed, more than would have hired the best workmen to accomplish the same labour; while the improvement of his lands is retarded, and the progressive rise of his rents is checked. P. 45.

Poor land cannot possibly pay *the same proportion of rent*, according to the amount of its produce, as the rich and fertile. The labour of ploughing, harrowing, sowing, &c. when the land is in cultivation, is nearly the same, and yet the produce is greatly inferior, not only in quantity, but in quality. Indeed, where the produce is inconsiderable, or the quality much inferior, the whole, or nearly the whole, may be swallowed up by the expence of labour, and no rent whatever can be afforded, more especially in adverse seasons.

The duration of the tenure must have a considerable effect, in fixing the rent. No farmer can afford to pay the same sum for land on a short, as if he held it on a long lease. The covenants, also, which are in fact a species of rent, must influence the money payments.

Rent must also depend on the capital invested in the cultivation of the farm. Thus, if a farmer can lay out only 4*l.* of capital per acre, he may not be able to afford for it a higher rent than 10*s.* per acre; if he lays out 7*l.* he may pay 14*s.*; and with a capital of 10*l.* per acre, he may be enabled to pay 18*s.* or 20*s.* of rent. Hence the advantage of wealthy tenants; and hence the justness of the maxim, "That capital in the hands of the tenantry, is of as much consequence as the quality of the land*."

It is obvious, that all the expences of a farm, must of necessity be defrayed by a sale of the produce, before any provision can be made for rent; and when these charges absorb more than the whole produce, there is nothing left for the payment of the landlord. The increase of the tenant's expences, taxes, assessments, tithes, law-charges, and stamps, as well as losses by bad debts, and otherwise, would have extinguished rent several years ago, if the price of the bushel of corn, and the pound of meat, had not advanced in proportion to the tenant's expences, and the other burdens to which he is liable. In the present circumstances of the country, high prices for corn and meat, are indispensably necessary to the existence of rent, more especially upon inferior soils†.

Upon the subject of rent, it is proposed to consider: 1. What proportion of the produce should be paid to the

* Annals of Agriculture, vol. xxiii. p. 338. Mr. Young here justly questions the good sense and understanding of those landlords, who argue against rich tenants;—who are jealous of seeing a farmer on a good horse,—and think it presumption in him to drink a bottle of wine. In other words, that is saying, that it is better to receive only 12*s.* than 20*s.* of rent, per acre.

† Communication from John Middleton, Esq.

landlord; 2. Whether a specific sum in money ought to be paid, or whether it should vary according to the price of produce; and, 3. At what periods the rent should be made payable.

1. *Proportion of Produce as Rent.*—This is a question, that has long been considered as abstruse, mysterious, and very difficult to resolve. Some have supposed, that one-fifth was a reasonable proportion, while others contend for a fourth, or even a third part of the produce of arable land*. But all former calculations on this subject, are rendered fallacious, by the effects of modern improvements. The rent ought certainly to depend upon the amount of the *disposable produce;* and that produce in grain, is greatly augmented, both by a diminution of the consumption on the farm, effected by improved implements†, and a more correct arrangement of labour, and likewise a better cultivation of the land in tillage. Hence, while the price of wheat has greatly advanced during the last twenty years, above the average price of the preceding twenty, the rent of land has not only risen, but in a higher proportion. More grain, and that of a better quality, has been produced on the same extent of land, and a greater amount of disposable surplus has gone to market‡.

Out of this surplus disposable produce, it is evident, that the rent must be paid. But it is difficult to divide its amount between the landlord and tenant, as so much depends upon the seasons, and on the prices of the different articles which the farm produces. In bad seasons also, every deficiency of produce, in the acres set apart for supporting home population, must be made up from the disposable surplus; nor is it possible to apply the same rules to all situations, soils, and climates, in all the various districts of an extensive country. It may be proper, however, to give some general idea, of the proportion of produce paid as rent, 1. In Scotland; and, 2. In England.

1. In Scotland, the following table states what is considered to be a fair proportion, where the land is cultivated.

* It is an old remark, that every arable farm ought to produce three rents; one for the landlord, one for the expence of management, and one for the farmer; to which a fourth ought now to be added, for taxes, and parochial assessments.

† The use of two-horse ploughs, and the invention of the thrashing-mill, by augmenting the disposable produce, have greatly augmented the rents in Scotland.

‡ Husbandry of Scotland, vol. ii. Appendix, p. 173. In Chapter V. shall be given, very important estimates of the amount of disposable surplus, on a clay land, and a turnip-soiled farm.

Table of Rent on Arable Farms.

	Per English Acre.
1. Where land produces 10*l.* 10*s.* per acre per annum, one-third, or	£3 10 0
2. Where land produces 6*l.* 12*s.* per annum, one-fourth, or	1 13 0
3. Where land produces only 4*l.* 5*s.* per acre, one-fifth, or	0 17 0*

In regard to grazing farms, they are let on principles totally different from the arable, namely, according to the quantity of stock they can maintain; and as they are not liable to the same expence of management, both the landlord and the tenant receive larger shares of the produce, than in the case of arable farms.

2. In England, on the other hand, the husbandmen and their landlords, are in a kind of partnership, in which the tenant provides all the capital, and undertakes the management of the whole concern; as a remuneration for which, and for the interest of the money he has invested in it, he is allowed, on arable land, equal to what is considered to be one moiety of the surplus, after defraying the expences of cultivation, the taxes to which he is liable for the farm he occupies, and every other outgoing†. Hay land requires much less of his attention, and for this he only obtains one-third of the surplus. But the profits of grazing, depending much on superior judgment in buying and selling stock, as well as skill in preventing, or curing their diseases, the grazier is entitled to a share of the surplus, fully equal to that of his landlord‡.

It has been contended, *as a general principle*, that as both the expence of cultivating land, and the value of its produce, are infinitely various, a farmer ought to calculate, what profit he can make *on his whole farm*, without entering into details; it being of little consequence to him, whether he pays at the rate of 10*l.* or 10*s.* per acre, provided he makes

* Dr. Coventry has drawn up "Estimates of the Produce and Rent of Arable Lands," varying according to the fertility of the soil, and on the climate or height of situation; with some explanatory observations, which are well entitled to the attention of proprietors, and their stewards, on the one hand, and the occupiers of the soil on the other.

† The nature of these deductions, from the actual produce, will be specified in a paper, written by John Middleton, Esq., which will be inserted in the Appendix, No. I.

‡ Communication from John Middleton, Esq.

an adequate interest *on the capital invested.* That is certainly a fair criterion on which a tenant may calculate what he ought to offer; but a landlord, in estimating the rent he ought to insist on, must take into his consideration, the produce that his land is capable of yielding, and what proportion of it, or of its value, at a fair average, he has reason to expect, under all the circumstances of the case, which ought not entirely to depend, on the exertions of a timid, or penurious tenant*.

What are the profits to which a farmer is entitled, is a subject of much dispute. On the one hand it is contended, that the produce of land, is of such universal and absolute necessity to the existence of mankind, that it is not reasonable it should yield to him who raises it, more than a fair profit†. On the other hand it is urged, that a farmer is entitled to be fully recompensed for the application of a considerable capital, exposed to the uncertainty of the seasons, when it is managed with economy, and conducted with industry and skill‡; and it has also been observed, that it is seldom more money is got by farming, than an adequate interest for the capital invested. This is owing to *competition*, the articles produced, being in numberless hands, who must bring them to market; and *necessity*, the goods of the farmer, being in general of a perishable nature, on the sale of which he depends, for the payments he has to make, and the subsistence of his family.

To prove how moderate the profits of farming in general are, it appears from the most careful inquiries, that *on arable farms* they rarely exceed from ten to fifteen per cent. on the capital invested§, which is little enough, considering that

* Husbandry of Scotland, vol. ii. p. 201.

† Worcestershire Report, p. 41. ‡ Berwickshire Report, p. 143.

§ In Bedfordshire (Report, p. 152), 10 per cent.; in Bucks, (Report, p. 97), 10 per cent.; in Berks, (Report, p. 114), 10 per cent.; in Sussex, (Report, p. 45), 10 per cent.; in Caithness, (Report, p. 49), 10 per cent.; in Kent, (Report, p. 49), 11 per cent.; in Dumbartonshire, (Report, p. 68), $11\frac{2}{3}$ per cent.; in Lincolnshire, (Report, p. 47), 12 per cent.; in Essex, (Report, vol. i. p. 106), 15 per cent. The profits of farming are not so much as is usual with manufacturers and traders, who often benefit from new inventions. Derbyshire Report, vol. ii. p. 40. Farming profits are sometimes increased by a large cultivation of some rare plant. Ditto. But on the whole, it appears, that the British cultivator is but poorly compensated for the capital he sinks, and for the labour he undertakes. With such unfavourable prospects, when this most useful class of the community can, with difficulty, obtain a livelihood by their exertions, it cannot be expected, that the agricultural interests of the nation will advance, more especially when there is to be added, the risk of unpropitious seasons, and an inundation of foreign corn.—*Remark by Edward Burroughs, Esq.*

few employments are more subject to casualties than farming, or require more uniform attention. Some arable farmers, possessed of superior skill and energy, and who have got leases on reasonable terms, may clear from fifteen to twenty per cent. while others, who are deficient in these qualities, or pay too high rents, frequently become insolvent.

In grazing farms the case is different, as they are attended with less expence of labour, and produce articles of a more luxurious description, for which a higher price will be given. Hence, in such farms, fifteen per cent. and upwards, is not unusual*. Besides, the grazier is more of a merchant than the mere arable farmer; is frequently buying as well as selling stock, and sometimes makes money by judicious speculations, though occasionally, from a sudden fall of stock, his losses are considerable. The grazier who breeds superior stock, and thence incurs great expence, is certainly well entitled, to more than common profit, for his skill and attention.

It has been observed, however, that a farmer seldom makes much money, unless he is most advantageously situated in the neighbourhood of a great town, or unites with farming, some other profitable employment. But those who have capital and ability, adequate to the management of more than one concern, merit to be amply rewarded for their superior skill and industry.

2. *Mode of paying Rents.*—In regard to the mode in which rent should be paid, it is proper to consider, whether the whole, or, at least, part of the rent, ought not to depend upon the price of grain, not for the season, but on an average of a certain number of years preceding that for which the rent is due. By this plan, neither the landlord, nor the tenant, can suffer from the fluctuating price of grain†; whereas, without some such arrangement, the tenant on the one hand, cannot make a fair offer of rent, lest the price of grain should fall too low; nor, on the other hand, can the landlord grant a lease of considerable duration, lest the price of grain should, in the progress of time, rise much higher. It seems therefore to be for the interest of both parties, that, on arable farms, a part of the rent should be payable in money, and part in corn, not in kind, but in money, according to the average value of a number of years.

* Cheshire Report, p. 12.

† Husbandry of Scotland, vol. ii. Appendix, p. 172; Derbyshire Report, vol. iii. p. 631, note.

This plan is enforced by law, to the extent of one-third, in college leases; and thus an income is secured, in some degree proportioned to the value of money.

This mode, however, is not without its difficulties. The amount of rent, for improvable, and well-cultivated farms, does not depend so much on the price of grain, as is commonly imagined. A large proportion of such farms, usually produce green crops, the value of which depends upon the prices of beef, mutton, and wool, and not on that of grain. Various circumstances also may arise, which may reduce the price of particular sorts of grain below its usual level, (for example, barley, when the distilleries are stopped); or may raise it disproportionably much higher, in case a large proportion of the wheat crop should be destroyed by rust or mildew*. But if the proposed payment, by the conversion of corn into money, be extended to the various sorts of grain usually cultivated in the district, *and be restricted to one half of the rent*, it does not seem liable to any material difficulty. If the payment also, depends, on the average of seven or more years, the main objection to a corn rent, that the farmer is often liable to pay the most, when he is the least able to do it, is removed.

3. *Periods of Payment.*—These ought to be made so convenient to the tenant, that he may not be under the necessity of selling the produce of his farm to disadvantage, for the sake of ready money; nor should he be compelled to pay his rent out of his capital, for that would cripple all his future exertions. The periods should vary according to the nature of the occupation, and the time when the tenantcy commenced. It is advisable, however, to have the rent payable at two periods of the year, in order to divide the burden of the payment, and that the tenant may not have any money unemployed, which too often leads to waste, and unnecessary expences.

On the whole, the most successful farmers are those, who embark a capital sufficiently large in their undertaking;—who feel it their duty to watch over that capital with unceasing care, and to add to it whenever it is practicable;—and who have agreed to pay a fair, but not a speculative rent, for the lands they cultivate†.

* Shropshire Report, p. 128.
† Malthus's Inquiry into the Nature and Causes of Rent, p. 58.

Sect. X.—*Parochial, National, and Miscellaneous Burdens.*

Besides the rent paid to the landlord, the farmers in England and Scotland, are subjected to the payment of various taxes, some of them imposed for local purposes, and others for the general expences of the state. The real amount of such burdens, every careful tenant ought accurately to know, before he bargains for his lease*. They may be classed under the following heads: 1. Parochial; 2. National; and, 3. Miscellaneous.

1. *Parochial Burdens.*

These are, 1. For the support of the clergyman; 2. For the maintenance of the poor; and, 3. In Scotland, for providing a parochial schoolmaster.

1. The mode of supporting the Clergy, in England†, by paying them a tenth part of the produce of the land in kind, was established in the christian world, when the revenue of the crown, and the rents of the proprietor, were paid in the same manner. But as the two latter are now commuted, no good reason can be assigned, why the former should not follow the same rule. It is certainly highly expedient for the public interest, that an ecclesiastical establishment should be maintained, and amply provided for, in proportion to the opulence of the country. It is not the total amount that is in general objected to, but the mode of payment, as one highly injurious to agriculture, and a bar to improvement. It is a great bar to improvement, because an improving farmer, one more enlightened or more spirited than his neighbours, would pay more tithe, by means of his outlay and exertions, but it is not certain that he would like-

* Dumbartonshire Report, p. 43. He should also ascertain if there are any local burdens or *servitudes* upon the farm, as a right of common, after the corn is harvested; a privilege of cutting down wood, &c. Such burdens render a farm less valuable. The vicinity of a rabbit-warren;—of landowners over-anxious about their game;—or the neighbourhood of hunts, or coursing clubs, are all deductions from *the rentable value* of a farm.—*Derbyshire Report*, vol. iii. p. 677.

† The same system prevails in Ireland, and is considered to be the principal cause of the periodical disturbances which have so frequently distracted the peace of that country. It is, however, only doing justice to the Irish Clergy to observe, that this imposition is in general, levied with moderation, when vested in their own hands; but it too often happens, that they leave their tithes to others, who, to enrich themselves, exact the utmost shilling which law or custom will authorise.—*Remark by Edward Burroughs, Esq.*

wise receive more profit. The produce would be more, but the expence would be greater. Nothing can be more obnoxious than a law, by which, when a person expends a large sum, either in reclaiming wastes, or augmenting the fertility of land already cultivated, he should be under the necessity of yielding up one-tenth of its produce to a person, who has been liable to no share of the expence,—who has run none of the risk,—and who has sustained none of the labour attending the improvement*.

Should the cultivation of corn become more operose, and require to be carried on with greater care, attention, and consequent expence, the burden of tithes will be still more severely felt†. At present, great loss is experienced, when they are exacted in kind, and conveyed, with much additional trouble and expence, not to the barns of the occupier, but to those of the parson‡. A commutation of tithe§, therefore, instead of its being exacted in kind, would be one of the greatest benefits that could be conferred on agriculture; and there is not the least difficulty in effecting it, by giving to the tithe-owner, either a proportion of the land, or by converting the tithe into a perpetual corn rent. Both these plans have been adopted in a variety of cases, by local acts in England, and they ought now to be enforced as a general system. Others recommend giving a proportion of the rent, (say 3*s*. or 4*s*. in the pound), to the tithe-owner; which they are inclined to consider the most likely plan to obviate every difficulty. It would at least put at end to any uncertainty as to the amount of the demand‖.

2. An assessment for the maintenance of the poor, is another parochial burden, which is annually increasing, and which, if not speedily regulated, upon proper principles, will inevitably absorb a very large proportion of rent in England¶. During infancy, in sickness, and in old age, assist-

* Brown's Treatise on Rural Affairs, vol. ii. p. 351; Derbyshire Report, vol. ii. p. 30.

† Worcestershire Report, p. 36.

‡ Kent Report, p. 42.

§ Among other objections to taking tithe in kind, it is none of the least importance, that a large proportion of the straw, the chief material from which manure is obtained, is carried off the farm, and the means of preserving its fertility thus impaired.

‖ Dr. Skene Keith states, in his Report of Aberdeenshire, p. 176, that no less a quantity than 2000 acres had been trenched in the neighbourhood of Aberdeen, at a heavy expence, which would not have been incurred, to any great extent, if tithes could have been exacted from the lands thus improved.

¶ Mr. Curwen remarks, that the daily augmentation of the poor-rates is

ance may be necessary; but, as Malthus justly observes, the poor-laws hold out support to the vicious and idle, at the expence of the prudent and the industrious. These payments also, destroy the spirit of independence, and those ideas of honest pride, which stimulate a man, to use his utmost exertions, in support of himself and his family*; and on its present footing, the boon is administered by the parish officers, with *caution* and *reluctance*, and received by the poor with *dissatisfaction* and *ingratitude*†. The payment of the poor-rates by the tenants, is attempted to be justified on two accounts: 1. With a view of guarding against unnecessary waste of money, in the temporary relief of the poor, which farmers are more likely to resist than landlords, who mostly reside at a distance; and, 2. To prevent new burdens being brought on parishes, by the hiring of yearly, instead of weekly labourers, and thereby settling them, and their future families on the parish‡.

In Scotland, the poor are, in general, maintained by voluntary contributions§; but when these are not found to be sufficient, the proprietors of the parish, with the clergyman and vestry, or *kirk-session*, are directed to make a list of the indigent persons in the parish, and then to impose an assessment for their relief; one-half to be paid by the proprietors, and the other half by the tenantry. Thus, in general, the people who pay the poor-rates, are both the judges of the indigence of those who claim charity, and the imposers of the assessment for their relief; and this, no doubt, is the best guard that could well be devised, against either an exorbitant assessment, or a prodigal distribution‖.

3. The system adopted in Scotland, by which there is a schoolmaster appointed in every parish, one-half of whose salary is paid by the farmer, is certainly a wise regulation, and becoming an enlightened nation. Why should not every individual in a country, be enabled to read and write, and to understand arithmetic? The acquisition of these branches

most severely felt, and whilst their oppressive effects are deprecated by all, as likely to absorb the whole landed rental of England, no specific plan for their immediate or progressive reduction, or their remote abolition, is suggested.—*Curwen's Report*, p. 32.

* Hereford Report, p. 40.

† Somerset Report, p. 36.

‡ Wilts Report, p. 28; Derbyshire Report, vol. iii. p. 184.

§ In Ireland, the same plan is adopted; and the most intelligent statesmen of that country are convinced, that it is the most judicious mode of relieving the poor.—*Remark by Edward Burroughs, Esq.*

‖ Clydesdale Report, p. 78.

of education, opens his mind, improves his morals, and fits him for being a better and more useful member of society. The means of acquiring these essential branches of knowledge, ought not to depend on the charitable disposition of reluctant contributors, but ought to be secured, to the poorest individual, by the municipal law of the land*.

2. *National Burdens.*

The national burdens in general, as the duties on houses and windows, and other assessed taxes; or assessments for the support of militia-men's wives and families, for the conveyance of vagrants, or the prosecution of felons, fall no heavier upon the farmer, than upon other classes of the community: but there is one impost which is severely felt by the arable farmer, namely, the tax on horses employed in husbandry. The inequality of that tax is strongly objected to; for lands, when pastured, and necessarily subject to the least expence, pay no part of it. The burden consequently falls exclusively on the lands in tillage, which, as a necessary consequence, must prevent the British farmer from raising the productions of arable land, so cheap as the foreign cultivator.

3. *Miscellaneous Burdens.*

There are likewise various miscellaneous burdens affecting the farmer, as statute assessments for bridges, which are of such public utility, that moderate rates for their maintenance, properly applied, cannot be objected to;—statute labour on the highways;—constable dues, which are seldom of much moment;—charges of the churchwardens, including the repairs of the church;—and in some populous parishes, there is sometimes a burial-ground tax. All these are paid by the occupiers. In some places also, there is a sewer's tax, chargeable on the landlords, where it is not otherwise settled

* The erection and repair of churches, houses for the Clergy, and schools, are parochial burdens, to which landlords in Scotland are liable. Scarcely a year passes, without some demand on that account, on the pockets of the proprietors, for one or more of these parochial buildings. The expence varies, according to the population and rent of the parish.

by express contract*. Adstriction to mills, however, is the severest burden, where it exists, for not only is the expence of grinding, double or treble what ought to be exacted, but the farmer is bound to carry his grain to be manufactured by a person, in whose skill or honesty he cannot always place any dependence†.

Whether the public burdens should be paid by the proprietor or the farmer, is a question of considerable importance. When paid by the latter, it is attended with this advantage, that the landlord has only to calculate on a real, and not an ideal income, and he limits his expence accordingly.

The vexations to which farmers in England are subjected, from various uncertain burdens, operates as a premium to Scottish agriculture. It is ingeniously and justly remarked, that physical circumstances are much more favourable to agriculture in England, than in her sister country; but these advantages are counteracted, by the accumulation of moral evils, which might be removed, if the legislature were to bestow, on matters connected with the internal improvement of the country, and the means for promoting it, a portion of that attention, which it so frequently gives, to the amelioration or improvement of our foreign possessions‡.

Concluding Observations.

Besides these, a variety of miscellaneous particulars require consideration, before a prudent farmer will finally resolve to undertake the cultivation of a farm; as, 1. The nature of the property on which the farm is situated; in

* As specifications are more satisfactory than general assertions, it may be proper to insert the payments made by a farmer in England, whose rent is annually 500*l.*

Tithes are compounded for at	£100	0	0
Poor's assessment is 5*s.* on the pound	125	0	0
Church assessment	6	5	0
Highway assessment	13	10	0
House tax and window tax	10	0	0
Horse tax and dog tax	7	10	0
Stamped receipts for these and other payments	1	15	0
The whole are very nearly 53 per cent., or	£264	0	0

—*Communication from John Middleton, Esq.*

† Clydesdale Report, p. 67; Derbyshire Report, vol. ii. p. 492.

‡ Brown's Treatise on Rural Affairs, vol. i. p. 185.

particular, whether the estate is entailed, and to what extent the possessor of the estate is authorized to grant a lease*.—2. The character of the landlord, and in case of his decease, that of his family, and of those whom they are likely to consult.—3. The real condition of the farm in regard to the enclosure, drainage, building, &c.; the crops it has usually produced, and the manner in which it has been managed for some years preceding.—4. The general state of the district, in regard to the price of labour, and the expence of living; the character of its inhabitants, in particular of the neighbouring farmers and labourers; and whether they are likely to promote, or to discourage, a spirit of improvement.

It is evident, that in hardly any one instance, can all the circumstances above enumerated, be favourably combined. But the active and intelligent farmer, will not be discouraged by the obstacles he may have to surmount; but will strenuously endeavour, by exertion, industry, and perseverance, to overcome the difficulties he must unavoidably encounter.

* See the Cornwall Report, p. 22, where an allusion is made to a most distressing circumstance; the author of that work having unwarily expended large sums on an entailed estate. This too often happens, and the unfortunate occupier is left at the mercy of his successor, if the lease given by the proprietor in possession, exceeds the time he is permitted by the entail, to grant such a deed.

CHAP. II.

ON THE MOST ESSENTIAL MEANS FOR CARRYING ON THE IMPROVEMENT AND CULTIVATION OF A FARM.

When a farmer enters on the occupation of any extent of land, a variety of most important objects must necessarily engage his attention, and the following in particular, as furnishing the most likely means of promoting his success. 1. The judicious expenditure of an adequate capital, in stocking the farm; 2. The keeping regular accounts, as the only sure foundation of economical culture; 3. The formation of a skilful arrangement of agricultural labour and domestic management; 4. The hiring a proper number of trusty farm servants; 5. The procuring skilful day-labourers when required for occasional purposes; 6. The purchase and maintenance of live stock suited to his farm; 7. The acquisition of the most suitable implements of husbandry; 8. The erection of buildings calculated for the objects to be pursued; 9. A command of water; 10. A division of his farm into fields of a proper size and shape; and 11. The construction of good private roads of communication, in cases where these have not been already executed. When all these particulars are satisfactorily arranged, he may then proceed, with spirit and energy, to the improvement and cultivation of his farm.

Sect. I.—*Capital.*

It is indispensable for the success of every undertaking, whether in farming, or any other branch of industry, that a sufficient capital to carry it on, should be at command. When there is any deficiency in that important particular, the farmer cannot derive an adequate profit from his exertions, as he would necessarily be frequently obliged to dispose of his crops for less than their value, to procure ready money; and it would restrain him from making advantageous purchases, when even the most favourable opportunities oc-

curred*. An industrious, frugal, and intelligent farmer, who is punctual in his payments, and hence in good credit, will strive with many difficulties, and get on with less money, than a man of a different character. But if he has not sufficient live stock to work his lands in the best manner, as well as to raise a sufficient quantity of manure;—nor money to purchase the articles required for the farm, he must, under ordinary circumstances, live in a state of penury and hard labour; and the first unfavourable season, or other incidental misfortune, will probably sink him under the weight of his accumulated burdens†. Farmers are too generally disposed, to engage in larger farms than they have capital to stock and cultivate. This is a great error; for it makes many a person poor upon a large farm, who might live in comfort and acquire property, upon one of less extent‡. No tenant can be secure without a surplus at command, not only for defraying the common expences of labour, but those which may happen from any unexpected circumstances§. When a farmer, on the other hand, farms within his capital, he is enabled to embrace every favourable opportunity of buying, when prices are low, and of selling when they are high‖.

The amount of capital required, must depend upon a variety of circumstances; as 1. Whether it is necessary for the farmer to expend any sum in the erection, or in the repair of his farm-house and offices; 2. What sum an incoming tenant has to pay to his predecessor, for the straw of the crop, the dung left upon the farm, and other articles of a similar nature; 3. The condition of the farm at the commencement of the lease, and whether any sums must be laid out in drainage, enclosure, irrigation, levelling ridges, &c.; 4. Whether it is necessary to purchase lime, or other extraneous manures, and to what extent; 5. On the period of entry, and the time at which the rent becomes payable, as this is sometimes exacted, before there is any return from the lands, out of the actual produce of which it

* Wilts Report, p. 26. It has been justly remarked, that farmers in general, cannot make their transfers of property, so frequently as manufacturers and merchants; hence they have occasion for, proportionally, even a greater capital at command. The shifts that farmers are often obliged to resort to, for raising money, are highly detrimental to their real interests.

† Marshall on Landed Property, p. 391.

‡ North Riding Report, p. 76. § Warwickshire Report, p. 43.

‖ Marshall on Landed Property, p. 392.

ought to be paid; and, lastly, on its being 1. a grazing, or 2. an arable farm, or 3. a mixture of both*.

1. *Grazing Farms.*—In pasture districts, the common mode of estimating the amount of capital necessary, is according to the amount of the rent; and it is calculated, that in ordinary pastures, every farmer ought to have at his command, from three to five times the rent he has agreed to pay. But in the more fertile grazing districts, carrying stock worth from 20*l.* to 30*l.* and even upwards, per acre, (as is the case in many parts of England), five rents are evidently insufficient. When prices are high, ten rents will frequently be required, by those who breed superior stock, and enter with spirit, into that new field of speculation and enterprise†.

2. *Arable Farms.*—The capital required by an arable farmer, varies according to circumstances, from 5*l.* to 10*l.* or even 15*l.* per English acre‡. An ignorant, timid, and penurious farmer, lays out the least sum he can possibly contrive; and consequently he obtains the smallest produce or profit from his farm. These, however, will always increase, when accompanied by spirit and industry, in proportion to the capital employed, if judiciously expended. At the same time, attention and economy cannot be dispensed with. It is ill-judged to purchase a horse at forty guineas, if one worth thirty can execute the labour of the farm; or to lay out sums unnecessarily upon expensive harness, loaded with useless ornaments§. Prudent farmers also, who have not a large capital at command, when they commence business, often purchase some horses still fit for labour, though past their prime, and some breeding mares, or colts; and in five or six years, they are fully supplied with good stock, and can sometimes sell their old horses without much loss. In every case, such shifts must be resorted to, where there is any deficiency of capital.

3. *A mixture of Arable and Grass Farming.*—This, on

* The culture of hops, a species of gardening, requires a capital of from 50*l.* to 60*l.* per acre.—*Young's Calendar*, p. 482.

† Leicestershire Report, p. 115.

‡ In Essex, 15*l.* per acre is necessary, where draining and chalking are essential. In Flanders, 6*l.* 5*s.* per English acre, is required. The sum is often lower, but then the farmer in general fails, unless he is assisted by an industrious family, or is fortunate in other respects.—*Hints on the Agricultural State of the Netherlands*, p. 9.

§ Cambridgeshire Report, p. 42.

the whole, is the most profitable method of farming. Independently of the advantages to be derived from the alternate husbandry, (which are always considerable), the chances of profit are much more numerous from a varied system, than where one object is exclusively followed. Where this mixed mode of farming is practised, the farmer will frequently rely on the purchase of lean stock, instead of breeding his own; and derives great advantage, from the quickness with which capital hus employed is returned. But, in that case, much must depend upon judicious selection.

It is not necessary to enter into any detailed estimates, of the capital required for stocking cultivated farms, as they have been already explained in former publications*. In general it may be said, that to stock a turnip-land arable farm, will require, at this time, 5*l.* or 6*l.* and a clay-land farm 7*l.* or 8*l.* per English acre, according to circumstances.

This capital is necessarily divided into two parts. The one is partly expended on implements, or stock of a more or less perishable nature, and partly vested in the soil; for this the farmer is entitled to a certain annual gain, adequate to replace, within a given number of years, the sum thus laid out. The other is employed in defraying the charges of labour, &c. as they occur throughout the year; the whole of which, with the interest, should be replaced by the yearly produce. These two branches of expence on a farm, are the first to be attended to, both in order of time, and in magnitude of amount.

The most satisfactory statement hitherto given, of the profit derived from the expenditure of an adequate capital in arable farming, is that furnished by George Rennie, Esq. of Phantassie, in East Lothian. On a mixed soil of 702 English acres, he states the profits at 1*l.* 5*s.* per English acre, or about 14 per cent. on the capital employed. On this subject, it has been well observed, that unless something commensurate to their skill, capital, and industry, is made by intelligent and industrious farmers, it would injure both the proprietors of land, and the public. Adventurers who possess but little capital, would occupy the farms, deceiving the proprietor, bv the offer of higher rents, than could be derived from the employment of insufficient

* Husbandry of Scotland, vol. ii. p. 182; General Report of Scotland, vol. v. p. 343.

capitals. The soil would consequently be inadequately cultivated, and the landlords, as well as the public, would sustain great loss*.

From the importance of capital to the farmer, it is evident, that where he unites prudence to energy, it would be of very great utility, to enable him to procure the use of capital, on as easy terms as the manufacturer or the merchant. He ought to gain at least from 10 to 15 per cent. on the capital he lays out†; and if so, he can conveniently pay 5 per cent. for the money he may have occasion to borrow. As the best means of enabling him to give adequate security, it has been suggested, that the farmer shall have the power of sub-letting his farm, or assigning his lease, always securing a preference to the landlord on equal terms. A prudent farmer, of respectable character, with such a security to offer, would never want credit when necessary; and his difficulties regarding capital, would in a great measure be done away‡. If this system were encouraged by liberal proprietors, persons possessed of ardent minds, and a turn for agricultural improvement, with a power of sub-letting under reasonable restrictions, might go on improving one farm after another, and thus be the means of bringing extensive tracts of country, even in remote districts, into a productive state. But this plan cannot take place, where the tenant is not enabled to pledge the improvements on his farm, as a security to his creditors.

Sect. II.—*Regular Accounts.*

The keeping of regular accounts is not so common among farmers as it ought to be; and in this respect, persons employed in other professions, are much more attentive and correct. Among gentlemen farmers, it is true, there is often a systematic regularity in all their proceedings; and their pages of debtor and creditor, of expence and profit,

* Husbandry of Scotland, vol. ii. p. 192. The statement is printed in the Appendix to this work, No. II. "On Farming Accounts."

† Essex Report, vol. i. p. 106.—Mr. Young observes, that if a farmer does not make ten per cent. on his capital, he must either have a bad farm, or manage it ill, or the times must be unfavourable. He ought to make from twelve to fifteen per cent. Some farmers make more, when the crops are good, and corn is at a fair price.—*Calendar*, p. 483.

‡ Husbandry of Scotland, vol. ii. p. 182. See the subject more fully entered into, p. 229.

are as strictly kept, as those of any banking house in the metropolis*. But with the generality of farmers, the case is widely different. It rarely happens, that books are kept by them in a minute and regular manner†; and the accounts of a farmer, occupying even a large estate, and consequently employing a great capital, are seldom deemed of sufficient importance, to merit a share of attention, equal to that bestowed by a tradesman, on a concern of not one-twentieth part of the value‡. There is certainly some difficulty in keeping accurate accounts, respecting the profit and loss, of so uncertain and complicated a business, as the one carried on by the farmer, which depends so much on the weather, the state of markets, and other circumstances not under his controul; but the great bulk of farming transactions is settled at the moment, that is to say, the article is delivered, and the money instantly paid; so that little more is necessary, than to record these properly. In regard to the expences laid out on the farm, an accurate account of them is perfectly practicable, and ought to be regularly attended to by every prudent and industrious occupier§. The Dutch wisely inculcate, "*that no one is ever ruined who keeps good accounts.*"

The advantage to be derived from regular accounts, cannot be doubted‖. By examining them, a farmer is enabled to ascertain, the nature, and the extent of the expence he has incurred, in the various operations of agriculture; and to discover what particular measures, or what general system,

* South Wales Report, vol. i. p. 180.

† Surrey Report, p. 107; Warwickshire Report, p. 43; North Riding Report, p. 77, &c.

‡ Herefordshire Report, p. 42; Warwickshire Report, p. 43; Surrey Report, p. 107, &c.

§ Husbandry of Scotland, vol. ii. p. 237.—Unless stock, for instance, keep at their original value, the farmer may be apparently a gainer, whilst in reality he is losing money.

‖ Besides the obvious advantages of enabling a man to understand his own affairs, and to avoid being cheated, it has a moral effect upon the farmer, of the greatest consequence, however small his dealings may be. Experience shews that men situated like small farmers (who are their own masters, and yet have very little capital to manage or to lose), are very apt to contract habits of irregularity, procrastination, and indolence. They persuade themselves that a thing may be as well done to-morrow as to-day, and the result is, that the thing is not done till it is too late, and then, hastily and imperfectly. Now nothing can be conceived better adapted to check this disposition, than a determination to keep regular accounts. The very consciousness that a man has to make entries in his books of every thing that he does, keeps his attention alive to what he is to do; and the act of making those entries, is the best possible training to produce active and pains-taking habits.

contributes to profit, or occasions loss*. The principle of *economy*, may thus be introduced into the management of a farm; and the lessening of expence effected, which is every day becoming of greater importance, bearing a higher proportion to the produce of the farm†.

In order to facilitate the adoption of so useful a plan, as the keeping of regular accounts, it would be of use, that not only memorandum books, for the transactions of the day, but account books were published, properly arranged, and divided into columns, containing every head, which experience in the business of farming may suggest, together with a broader column for general observations. The accounts of gentlemen farmers, or of the bailiffs they employ, cannot be too minute‡; but in regard to common farmers, the great objects are, to have them short and distinct. Models of such accounts will be in Appendix, No. II.

It is proper to add, that to record pecuniary transactions, is not the only object to be attended to in the accounts of a farmer. It is necessary to have an annual account of the live stock, and of their value at the time;—of the quantity of hay unconsumed;—of the grain in store, or in the stack-yard;—and of the implements and other articles in which the capital is invested. An account, detailing the expence and return of each field, according to its productive contents, is likewise essential, without which, it is impossible to calculate the advantage of different rotations;—the most beneficial mode of managing the farm;—or the improvements of which it is susceptible§.

* Bedfordshire Report, p. 160; Herefordshire Report, p. 42.—The ancient Romans were perfectly aware of the necessity of economy, in cultivation. It was a caution given by Varro, to take care, "*Ne sumptus fructum superet.*" Let not the expence exceed the return. And Pliny, is even more pointed, since he delivers as a maxim, "Bene colere lucrosum, optime colere, damnosum." To till well is profitable; but profuse agriculture is ruinous.—*Coventry's Discourses*, p. 58.

† By carefully examining the accounts of the smith, the carpenter, and other tradesmen employed by the farmer, important savings of expence may be effected.

‡ Mr. Francis Blaikie, formerly bailiff to the Earl of Chesterfield, and now to Mr. Coke of Norfolk, besides his accounts of money transactions, and an accurate valuation of stock, both dead and alive, annually made out records, of even the most minute particulars; for instance, respecting a hay-stack—the date when carried in; where from; number of waggon-loads; how got in; and the estimated number of tons;—whilst on the opposite side is entered, the date when cut; where used; by what stock, &c.—*Derbyshire Report*, vol. ii. p. 40.

§ This subject is fully discussed in Young's Farmer's Calendar, p. 533 to 549.

Sect. III.—*Arrangement of Agricultural Labour, and Domestic Management.*

To conduct an extensive farm well, is not a matter of trivial moment, or to the management of which every one is competent. Much may be effected by capital, skill, and industry; but even these will not always ensure success, without judicious arrangement. With it, a farm furnishes an uninterrupted succession of useful labour, during all the seasons of the year; and the most is made that circumstances will admit of, by regularly employing the labouring persons and cattle, at such works, as are likely to be the most profitable Under such a system, it is hardly to be credited, how little time is lost, either of the men or horses, in the course of a whole year. This is a great object; for each horse may be estimated at three shillings per day, and each man at two shillings. Every day, therefore, in which a man and horse are unemployed, occasions the loss of at least five shillings to the husbandman.

As the foundation of a proper arrangement, it is necessary to have a plan of the farm, or at least a list of the fields or parcels of land into which it is divided, describing their productive extent*,—the quality of the soil,—the preceding crops,—the cultivation given to each,—and the species and quantity of manure they have severally received. The future treatment of each field, for a succession of years, may then be resolved on, with more probability of success.

With the assistance of such a statement, every autumn, an arrangement of crops for the ensuing year, ought to be made out; classing the fields or pieces of land, according to the purposes for which they are respectively intended. The number of acres allotted for arable land, meadow, or pasture, will thus be ascertained. It will not then be difficult to anticipate, what number of horses and labourers will be required during the season for the fields in culture, nor the live stock that will be necessary for the pasture land. The works of summer and harvest will likewise be foreseen, and proper hands engaged in due time to perform them†.

As nothing contributes more to facility and satisfaction in

* The extent should only contain the land cultivated; the fences and borders on a farm, should be thrown into one mass.—*Young's Calendar*, p. 588.

† Marshall on Landed Property, p. 419.

business, than to prepare for what must be done, a farmer should have constantly in view, a judicious rotation of crops, according to the nature and quality of his soil, and should arrange the quantity and succession of labour accordingly. Team labour, when frost and bad weather do not intervene, should be arranged for some months; and hand labour, for some weeks, according to the season of the year. "A general memorandum list of business to be done," is therefore essential, that nothing may escape the memory, and that the most requisite work may be brought forward first, if suitable to the state of the weather*. In this way, the labour will go on regularly, and without confusion, while by a proper attention, either a distribution of labour, or an occasional consolidation of it, may be applied to every part of the farm†.

The following rules, connected with the arrangement, and the successful management of a farm, are particularly to be recommended.

1. The farmer ought to rise early, and see that others do so. In the winter season, breakfast should be taken by candle light, for by this means, an hour is gained, which many farmers indolently lose; though six hours in a week, are nearly equal to the working part of a winter day. This is a material object, where a number of servants are employed. It is also particularly necessary, for farmers to insist on the punctual performance of their orders.

2. The whole farm should be regularly inspected, and not only every field examined, but every beast seen, at least once a day, either by the occupier, or by some intelligent servant.

3. In a considerable farm, it is of the utmost consequence, to have servants specially appropriated for each of the most important departments of labour; for there is often a great loss of time, where persons are frequently changing their employments. Besides, where the division of labour is introduced, work is executed not only more expeditiously, but also much better, in consequence of the same hands being constantly employed in one particular department. For that purpose, the ploughmen ought never to be employed in manual labour, but regularly kept at work with their horses, when the weather will admit of it.

* Marshall on Landed Property, p. 420. The Farmer's Calendar, published by Mr. Arthur Young, contains much valuable information, and would furnish many useful hints, *for the general memorandum book of business to be done.*

† Leatham's Survey of the East Riding, p. 61.

4. To arrange the operation of ploughing, according to the soils cultivated, is an object of essential importance. On many farms there are fields, which are soon rendered unfit to be ploughed, either by much rain, or by severe drought. In such cases, the prudent farmer, before the wet season commences, should plough such land as is in the greatest danger of being injured by too much wet; and before the dry period of the year sets in, he should till such land as is in the greatest danger of being rendered unfit for ploughing by too much drought. The season between seed-time and winter, may be well occupied in ploughing heavy soils, intended to be laid down with beans, oats, barley, and other spring crops, by means of the scarifier. On farms where these rules are attended to, there is always some land in a proper condition to be ploughed; and there is never any necessity, either for delaying the work, or performing it improperly.

5. Every means should be thought of, to diminish labour, or to increase its power. For instance, by proper arrangement, five horses may do as much labour as six perform, according to the usual mode of employing them. One horse may be employed in carting turnips during winter, or in other necessary farm work at other seasons, without the necessity of reducing the number of ploughs. When driving dung from the farm-yard, three carts may be used, one always filling in the yard, another going to the field, and a third returning; the leading horse of the empty cart ought then to be unyoked, and put to the full one. In the same manner, while one pair of horses are preparing the land for sowing turnips, the other three horses may be employed in carrying the dung to the land, either with two or three carts, as the situation of the ground may happen to require. By extending the same management to other farm operations, a considerable saving of labour may be effected.

6. A farmer ought never to engage in a work, whether of ordinary practice, or of intended improvement, without previously giving it the best consideration of which he is capable, and being satisfied that it is advisable for him to attempt it; but when begun, he ought to proceed in it with much attention and perseverance, until he has given it a fair trial.

7. It is a main object, in carrying on improvements, not to attempt too much at once; and never to begin a work,

without a probability of being able to finish it in due season*.

8. Every farmer should have a book for inserting all those useful hints, which are so frequently occurring in conversation, in books, or in the practical management of a farm. Loose pieces of paper are apt to be mislaid or lost, and when a man wishes to avail himself of them, for examining a subject previously investigated and discussed, he loses more time in searching for the memorandum, than would be sufficient for making half a dozen new ones. But if such matters are entered into a book, and if that book has a table of contents or index, he can always find what he wants, and his knowledge will be in a progressive state of improvement, as he will thus be enabled, to derive advantage, from his former ideas and experience†.

By the adoption of these rules, every farmer will be master of his time, so that every thing required to be done, will be performed at the proper moment; and not delayed till the season and opportunity have been lost. The impediments arising from bad weather, sick servants, or the occasional, and necessary absence of the master, will, in that case, be of little consequence, nor embarrass the operations to be carried on; and the occupier will not be prevented, from attending to even the smallest concerns connected with his business, on the aggregate of which his prosperity depends‡.

Besides an arrangement for carrying on operations without, a settled plan, for the management of the family within, ought not to be neglected. In regard to house-keeping, the safest plan is, not to suffer it to exceed a certain sum weekly, stating the value of every article taken from the farm. An annual sum should be allotted for clothing, and the personal expences of the farmer, his wife, and children, which ought not to be exceeded. The whole allotted expence, should be considerably within the probable receipts; and at least one-eighth of the income actually received, should be laid up for contingencies, or expended in *extra* improvements on his farm, if it belongs to the farmer in property, or is held for a term of years§.

* Marshall on Landed Property, p. 420. † Young's Calendar, p. 51.
‡ Leatham's Survey of the East Riding, p. 61.
§ Young's Calendar, p. 437.

Sect. IV.—*Farm Servants.*

The domestic servants employed in carrying on the operations of a farm, are of four descriptions: 1. Bailiffs, overseers, or upper servants; 2. Ploughmen, and inferior male servants; 3. Apprentices for agricultural purposes, where such are to be had; and, 4. Female servants.

1. *Upper Servants.*—In all large farms, a bailiff or overseer is necessary, to assist the farmer in carrying on so extensive and complicated a concern, and more especially to act for him in cases of absence or sickness. His business is, to be perpetually on the watch, wherever persons or teams are employed, consequently he must not work himself, which would confine him to one spot. He should be invested with sufficient authority, to compel the other servants and labourers to do their duty; and if he does not hire them, he should at least have the power of dismissing them, subject to the farmer's concurrence. All market transactions, however, and all buying, selling, bargaining, and receiving money, should be done by the master*. If the bailiff be a person of the better sort, and single, many advantages result from his eating at the farmer's table†.

2. *Inferior Servants.*—These consist of ploughmen, shepherds, cow-herds, carters, &c. Of these, the ploughmen are the most important, for on them, in a great measure, depends the success of all the crops‡.

It is interesting to trace the manner in which these inferior servants, have been progressively maintained.

In former times, the servants lived at the same table with their masters, and that is still the practice in those districts where the farms are small§. On moderate-sized, and on large farms, they are usually sent to a separate table; but of late a custom has been introduced, of putting them on board-wages. This is a most pernicious practice; which often leads them to the ale-house, corrupts their morals,

* Young's Calendar, p. 483. † Ibid. p. 485.

‡ The ploughing-matches so frequent in England, Scotland, and Ireland, have been the source of much improvement in this important operation.

§ Bedfordshire Report, p. 582.—This practice prevails much in Flanders. It is productive of much order and decency at meals; and the farmer is thus enabled to return with his men to the work, which may not be the case, when they eat separately.—*Comm. from the Rev. Thos. Radcliffe.*

and injures their health*. It is a better plan, with a view of lessening trouble, to board them with the bailiff; but it is still more desirable for the farmer, to have them under his own eye, that he may attend to their religious and moral conduct. He will find much more useful assistance, from the decent and the orderly, than from the idle and the profligate†.

In consequence of the great advance in the price of provisions, and the difficulty of pleasing persons with the fare prepared for them, (who often make a clamour about a trifling alteration in their diet, perhaps from circumstances unavoidable), it is the practice, in the vicinity of the metropolis, to diminish the number of domestic servants of every description, and instead of annual servants, to hire day-labourers‡. But these occasional servants are unsteady, continually wandering from one master to another§, and are very precarious supports of a tillage farm: for they may quit their service at the most inconvenient time, unless bribed by higher wages; and the farmer may thus lose the benefit of the finest part of the season‖. Where day-labourers, however, are married, they are more to be depended upon, than unmarried domestic servants, more especially when the labourer has a family, which ties him down to regular industry¶.

The following plan of maintaining the *hinds*, or ploughmen, in the best cultivated districts in Scotland, is found by experience to be greatly superior to any other mode hitherto adopted.

1. Proper houses are built for the farm-servants, contiguous to every farmstead**. This gives them an opportunity of settling in life, and greatly tends to promote their future welfare. Thus also the farmer, has his people at all times within reach, for carrying on his business.

2. The farm-servants also, when married, receive the greater part of their wages in the produce of the soil, which gives them an interest in the prosperity of the concern in

* Young's Norfolk, p. 48.
† Young's Calendar, p. 485.
‡ Bedfordshire Report, p. 580.
§ Surrey Report, p. 540.
‖ Monmouthshire Report, p. 96.
¶ Staffordshire Report, p. 157.

** Mr. Curwen has erected a dozen of cottages for his carters, adjoining to his farm buildings, that the excuse of being a mile and a half from the stables, should cease to be an apology for due attention to the horses, and cleaning and dressing them at eight o'clock every night; it being a well founded maxim, that good grooming is as necessary, and almost equal to good feeding. The advantages derived from this alteration, soon became apparent.—*Curwen's Report*, p. 78.

which they are employed. Under this mode of payment, they are certain of being supplied with the necessaries of life, and a rise of prices does not affect them. Whereas, when their wages are paid in money, they are exposed to many temptations of spending it, which their circumstances can ill afford; and during a rise of prices, they are sometimes reduced to considerable difficulties. From the adoption of an opposite system, habits of sobriety and economy, so conspicuous among the farm servants in Scotland, and the advantages of which cannot be too highly appreciated, have arisen, and still prevail in these districts.

3. A most important branch of this system is, that almost every married servant has a cow, of a moderate size, kept for him by the farmer, all the year round. This is a boon of great utility to his family. The prospect of enjoying this advantage, has an excellent effect upon the morals of young unmarried servants, who, in general, make it a point, to lay up as much of their yearly wages, as will enable them to purchase a cow, and furniture for a house, when they enter into the married state. These savings, under different circumstances, would most probably have been spent in dissipation.

4. They have also several other perquisites, as a piece of ground for potatoes and flax, (about one-eighth part of an acre for each); liberty to keep a pig, and half a dozen hens; their fuel is carried home to them; they receive a small allowance in money per journey, when sent from home with corn, or for coals or lime; and during the harvest, they are maintained by the farmer, that they may be always at hand.

There are no where to be met with, more active, respectable, and conscientious servants, than those who are kept according to this system. There is hardly an instance of their soliciting relief from the public. They rear numerous families, who are trained to industry, and knowledge in the operations of agriculture, and whose assistance in weeding the crops, &c. is of considerable service to the farmer. They become attached to the farm, take an interest in its prosperity, and seldom think of removing from it*.

Under this system, every great farm is a species of little

* This system is fully detailed in the Husbandry of Scotland, vol. ii. p. 240, also in the General Report of Scotland, vol. iii. p. 226. See likewise the West Riding Report, p. 13, and the Surrey Report, p. 540. Both in Berwickshire and Roxburghshire, many farmers have but one unmarried male servant kept on their farm.—*General Report of Scotland*, vol. iii. p. 241, note.

colony, of which the farmer is the resident governor. Nor, on the whole, can there be a more gratifying spectacle, than to see a large estate, under the direction of an intelligent landlord, or of an agent competent to the task of managing it to advantage; where the farms are of a proper size, where they are occupied by industrious and skilful tenants, anxious to promote, in consequence of the leases they enjoy, the improvement of the land in their possession; and where the cultivation is carried on by a number of married servants, enjoying a fair competence, and rearing large families, sufficient, not only to replace themselves, but also, from their surplus population, to supply the demand, *and even the waste*, of the other industrious classes of the community. Such a system, there is no reason to believe, is brought to a higher degree of perfection, and carried to a greater extent, in the more improved districts of Scotland, than perhaps in any other country in Europe*.

The mode of hiring servants, at what are called *public statutes*, so general in many parts of England, is justly reprobated, as having a tendency to vitiate their minds, enabling them to get places without reference to character, exposing good servants to be corrupted by the bad, promoting dissipation, and causing a cessation of country business for some days, and an awkwardness in it for some time afterwards†.

When hiring servants, it would be extremely important, if possible, to get rid of any injurious perquisites, which are often prejudicial to the interests of the master, without being of any advantage to the servant. For instance, in Yorkshire, and in other districts, it is a custom, to give farm servants liquor, both morning and evening, whatever is the nature and urgency of the work. Nothing can be more absurd, than permitting a ploughman to stop for half an hour, in a winter day, to drink ale, while his horses are neglected, and shivering with cold‡.

3. *Apprentices.*—In several parts of England, particularly in the western counties, a number of farm servants, from the poverty of their parents, lay the basis of their education, and training in husbandry, as parish apprentices. This is founded on the Act of the 43d of Elizabeth, but it is not so generally enforced as it ought to be. It is in some cases

* Husbandry of Scotland, vol. ii. p. 280.
† Leicestershire Report, p. 302. ‡ West Riding Report, p. 203.

extended to females, though, when young, they have not strength for many of the common labours of agriculture. But nothing can be urged against boys being so instructed and trained; and such are uniformly found afterwards, to make the best servants, and to be the steadiest and best labourers*.

In Scotland, the plan of apprenticeships, with a view of training servants or labourers to husbandry, is not in practice; but it has been adopted, for the purpose of *educating farmers* for their professional duties. As this seems to be an admirable plan, it is proper to select an example of it. Mr. Walker, of Mellendean, an eminent farmer in Roxburghshire, who rents about 2866 acres of arable land, and is distinguished for his skill in agriculture, takes young men under him as apprentices, who, instead of receiving wages, have uniformly paid him ten pounds each. Some of them remain with him two years, but the greater number only one. They eat in his kitchen, where they have always plenty of plain wholesome food. He takes none who are above living in that way, or who will not put their hand to every thing going forward on the farm. He has sometimes been offered ten times the above sum, to take in young gentlemen to eat and associate with his own family, but that he has uniformly declined. These young men, have an opportunity of attending to every operation of husbandry, as practised on Mr. Walker's farm; and are taught to hold the plough, to sow, to build stacks, &c. He considers them, on the whole, rather profitable than otherwise, and in some seasons, he finds them particularly useful†.

4. *Female Servants.*—These are principally employed in the dairy, in which their skill and diligence are usually in the highest degree praiseworthy. Men often milk the cows, but are not so well calculated as females, for the management of the interior of the dairy house, where so much depends upon attention to cleanliness. Female servants are likewise usefully employed in weeding, in hay-making, at harvest, and in barn-work; and are well entitled to the inferior wages usually given them.

* Devon Report, p. 359; Cornwall Report, p. 85.
† Husbandry of Scotland, vol. ii. p. 106.

Sect. V.—*Labourers in Husbandry.*

Next to the ploughmen and other hired farm-servants, labourers employed in executing the several branches of incidental works upon a farm, are the most valuable to the arable farmer, as without a sufficient supply of such hands, it is impossible for him to carry on the various operations connected with an accurate system of agriculture, either in a perfect manner, or in the proper seasons of the year. It is evident indeed, that the farmer, who depends entirely on his regular farm-servants, whose chief employment is working with horses, must either allow many necessary jobs, that daily occur, to lie over; or if these are performed by the ploughmen, the horses must often be completely idle. Wherever agriculture, therefore, is carried on in any thing like a perfect system, it is always a matter of essential importance for the farmer, to have at his command, a sufficient number of such useful assistants*.

This interesting subject of labourers in husbandry, includes the following particulars: 1. The division of labourers in regard to their possessions; 2. The distinction between day-labourers, and those who work by the piece; 3. Female labourers; 4. The hours of working; 5. The rate of wages; 6. The practice of giving grain, &c. at a cheap rate to labourers; 7. The effect of high wages; and, 8. The advantages of labourers being trained to diligence and activity.

1. *Classes of Labourers according to their Possessions.*—With a view to the possessions held by labourers, they may be divided into five classes; 1. Those who have a house, but no land; 2. Those who have a right of common; 3. Those who have a garden, or potatoe ground; 4. Those who have some arable land; and, 5. Those who have grass land.

1. Where a labourer has only a cottage to protect him from the inclemency of the weather, he cannot have the same attachment to his dwelling, as if he had some land annexed to it; nor is such a state of the labourer so beneficial to the community. When a labourer has a garden, his children learn to dig and weed, and in that manner some of their time is employed in useful industry. If he is possessed of a cow, they are taught early in life, the necessity of taking care of cattle, and acquire some knowledge of their treat-

* General Report of Scotland, vol. iv. p. 237.

ment. But where there is neither a garden to cultivate, nor any cow kept, they are not likely to acquire either industrious or honest habits*.

So strongly were these ideas formerly prevalent, that by the 43d of Elizabeth, no cottage could be built on any waste, without having four acres attached to it. This is now by far too much. If the quantity were reduced to half an acre for a garden, and if no person could gain a settlement who was not a native, or, if a stranger, who did not fairly rent, in the same parish, a house and land worth twenty, instead of ten pounds per annum, both the poor and the public, would thence derive very essential benefits†.

2. In many cases in England, cottagers have no land or garden, but a right of common. This is of little or no real benefit to them, unless to obtain fuel, the advantage of which is great, and not easily compensated. With a common-right for a cow, or a few sheep, cottagers get an idea of visionary independence, which renders them unfit for the duties of their station‡. A labourer of this description, is entirely spoiled for industry, and the generality of experienced persons in country matters, must have seen many cases in point. Forest-side cottages in particular, are nurseries of idleness, and seminaries of mischief §.

3. No labourer in the country, can be in a comfortable state without a garden, or at least some ground to cultivate for potatoes. The advantages attending such possessions, shall afterwards be more fully detailed. (See Chap. IV. Sect. 4).

4. In some cases, the cottager has good summer pasture, or can hire it in the neighbourhood, and can raise, on arable land in his occupation, turnips and other winter food for a cow. This plan is adapted to countries, where is a mixture

* Letter from the Earl of Winchilsea; Communications to the Board of Agriculture, vol. i. p. 30. Many instances are known in Ireland, of labourers who were idle and ill conducted, becoming industrious and peaceable, on obtaining an acre or two of land, to engage them in domestic pursuits. Indeed the Irish peasant prefers what he terms, "*his little garden*," to any increase of wages which might be considered an equivalent: it is, however, often the case, that his poverty incapacitates him from cultivating it to advantage, and thence it becomes a burthen to him: being necessitated to pay a heavy rent, and foregoing, for that accommodation, a certain portion of his wages.—*Remark by Edward Burroughs, Esq.*

† Remarks by Sir John Thomas Stanley, Bart. Cheshire Report, p. 87, note. The gaining of a settlement, by a year of hired servitude, is the occasion of endless feuds and frauds, litigation and expence.

‡ Berkshire Report, p. 75. § Marshall on Landed Property, p. 105.

of arable and grazing land; but it is objected to, in the more cultivated districts, as taking up too much of the time of the labourer*.

5. The most advantageous system, however, for keeping a cottage cow, is that adopted in grazing districts, where a cottager has a sufficient quantity of enclosed land in grass, to enable him to keep one or two cows both summer and winter, grazing the one half, and mowing the other, alternately†.

It may be proper to add, that nothing tends more materially to teach the poor honesty, than allowing them to have property which they can call their own. Feeling how intensely they would deprecate all infringement upon it, they are less likely to make depredations upon the property of others; and this will produce more honesty among them, than the best delivered precepts can instill‡. By the cultivation of a small spot of land, a cottager not only acquires ideas of property, but is enabled to supply himself with that variety of food, as fresh vegetables in summer, and roots in winter, which comfort and health require. If he should fortunately be able to keep bees in his garden, and if its surplus produce should also enable him to rear, and still more, to fatten a hog, his situation would be much ameliorated§. But if, in addition to all these advantages, he can keep a cow, the industrious cottager cannot be placed in a more comfortable situation.

2. *Labourers by the Day or the Piece.*—On this subject there is a great diversity of opinion.

In favour of working by the great, or piece, it is urged: 1. That when a number of labourers work together *by the day*, much time is lost in idle conversation‖; 2. That it is extremely difficult to oversee a number of workmen, and to keep them to their duty¶; 3. That working by the piece, is the only way by which an active and diligent labourer can

* In Ireland, the labourer has, in some cases, grass for a cow supplied by the occupier of the farm, during the six summer months, at from two to three guineas; and with his cottage, at least a plantation acre, one half for potatoes, the other for winter forage for his cow.—*Communication from the Rev. Thomas Radcliffe.*

† Others recommend, as a better system, constantly to mow one half of the land, and to pasture the other, as grass is most productive, when it is uniformly treated according to the same system.—*Communications to the Board of Agriculture*, vol. iii. p. 191.

‡ Buckinghamshire Report, p. 46.

§ Marshall on Landed Property, p. 150.

‖ Kent Report, p. 194.

¶ Holt's Lancashire, p. 183.

be rewarded for his superior exertion*; 4. That he works with more steadiness and perseverance, when he is satisfied that it is in his power to apply the fruits of his extraordinary labour, to the benefit of his family†; 5. That he likewise works with greater satisfaction to himself, being more independent in regard to time, and less under control‡; 6. That the employer has the advantage of having his work executed with dispatch§; and, 7. That the community is benefited, in proportion to the additional quantity of labour thus performed, by the same number of individuals‖.

On the other hand it is contended, that piece-work is not always so durable, nor so well executed; and that such engagements, are a strong inducement to labourers, to overwork themselves; insomuch that those, who make a practice of engaging in task-work, soon wear themselves out by their extra exertions, and become old men at fifty¶.

Contract work, *or by the great*, is however daily gaining ground; and in Middlesex in particular, a moiety or more, of the whole labour in carrying on farming operations, as mowing, reaping, &c. is done by the piece**.

The practice of mowing grass by piece-work, is to be preferred on the following grounds: 1. Because by doing more work, fewer hands are required, at a time when they are commonly *much in demand;* and, 2. Because, in consequence of such expedition, the object of securing the hay is much sooner accomplished, which is often of *incalculable importance*††.

In regard to the corn harvest, it entirely depends upon the season and the climate. When the work is done by the day, the week, or the month, it certainly requires attention, to see that the men work properly; but in harvest, hours are not much considered, and those who are employed in it, when the weather is favourable, work in general without reluctance, with moderate encouragement, as long as it is

* West Riding Report, p. 204.

† Donaldson's Modern Agriculture, vol. i. p. 135.

‡ Suffolk Report, p. 223, note.

§ General Report of Scotland, vol. iii. p. 247.

‖ Kent Report, p. 194.

¶ Holt's Lancashire, p. 183; Staffordshire Report, p. 158.—This objection may be urged in the case of manufacturers, but is certainly not so applicable to those who are employed in agriculture.—*Remark by Edward Burroughs, Esq.*

** Middlesex Report, p. 380.

†† Mr. Dudgeon of Prora's statement; General Report of Scotland, vol. iii. p. 347, note.

practicable*. When the harvesting is carried on by piece-work, the farmer must be equally upon the watch, lest the corn should be cut down in a damp state, or the reaping carelessly executed, or that it should be brought in before it is perfectly dry. Reaping the corn, binding the sheaves, and setting them up to dry, is, however, frequently executed by the acre. The subsequent care of the sheaves, as well as carting them, and making the corn-stacks, is a separate concern, which is generally done by the teams of the farmer, under his own superintendance. When corn is reaped by the method called *bagging*, it is more easily, and readily cut low, than high; for that reason, and for obtaining more straw, as well as placing the land in better condition for the plough, nearly all the corn is so reaped, in the neighbourhood of London†.

One great objection to piece-work is, that it is often imperfectly done, which occasions disputes between the parties. But this difficulty can, in many cases, be easily obviated. Let a specimen be made at the commencement, and a penalty fixed for any variation from it; or let the contractor be bound to accept of day-wages, at a fair rate, after all his exertions, if he is detected in doing injustice to his employer: This has been often acted upon with a happy effect‡. Indeed a proper attention to persons while executing the task, or reducing their hire, if the work is not executed in a proper manner, is an effectual mode of preventing, or punishing imposition§.

3. *Female Labourers.*—Women are very fit for taking a share in the lighter toils of agriculture, such as weeding, hoeing, reaping, hay-making, &c. Multitudes of them are thus employed in the neighbourhood of the metropolis. They are mostly from North Wales, and are distinguished for their industry, and their healthy appearance‖. In many parts of the kingdom also, women are employed in reaping corn, and when trained to it from their infancy, become extremely expert in that operation.

4. *Hours of Working.*—Ten hours is the general length of time for a day's work, during the spring, summer, and autumn quarters. Farmers, however, are not at all uniform

* In Herefordshire, labourers have worked in harvest fifteen hours a day Report, p. 158.

† Communication from John Middleton, Esq.

‡ General Report of Scotland, vol. iii. p. 248, note.

§ Remark by Edward Burroughs, Esq.

‖ Middlesex Report, p. 382.

in their hours of working during these periods. Some begin at five o'clock, rest three hours at mid-day, during the more violent heat of the sun, and fill up their day's work, by beginning again at one o'clock, and ending at six in the evening. Others begin at six, and end at six, allowing half an hour at breakfast and an hour at dinner. But although these be the ordinary hours, both for servants and labourers, during the more busy seasons of the year, yet neither of them will scruple to work either sooner or later, when occasion requires*. In regard to the winter months, the hours of labour are from the dawn of morning, as long as it is light, with the allowance of about half an hour at mid-day for dinner.

5. *Rate of Wages.*—It is a general principle, that the rate of labour, must in a great measure depend upon the price of grain. In England, the value of a peck of wheat, and in Scotland, of a peck of oatmeal, (being the principal articles of subsistence of the lower orders of the people in the two countries), were long accounted an equivalent to the daily pay of a labourer. In both countries, however, the price of potatoes has, of late years, had a considerable influence in the rate of labour†; and in England, the effects of the poor laws, have tended to keep down that rate, below the increased price of provisions, and thus have deranged the natural progress of rural economy. It has been ascertained, that a man, his wife, and from two to three children, if wheat is their habitual food, will require ten gallons weekly‡. When they live on bread, hard working people ought to have the best kind, as that will furnish the most nutrition. How then could a labourer and his family exist, upon wages of from 6*s.* to 9*s.* per week, when wheat is from 8*s.* to 10*s.* or 12*s.* per bushel§? The difference is compensated by the poor-rates, a most exceptionable mode of making up the deficiency; for labour would otherwise have found its own level, and the labourer would have obtained the price of a bushel and a half of wheat weekly.

In Scotland, the rate of labour has increased beyond the

* General Report of Scotland, vol. iii. p. 346.

† It is believed, that, in point of nourishment, one peck of oatmeal, weighing 8¾ lbs. avoirdupois, will go as far in supporting a family, as two pecks or 56 lbs. of potatoes. The peck of oatmeal is not half the price of a peck of wheat. The weight of the latter is from 14 lbs. to 15 lbs.

‡ This was ascertained by a respectable magistrate, Sir George O. Paul, Bart. on the most careful enquiry. See his Letter addressed to Sir John Sinclair, written an. 1796, p. 7.

§ Staffordshire Report, p. 158.

price of provisions. Prior to 1792, the average price of a peck of oatmeal was 1*s.* 1*d.* and the average price of a day's labour in summer, 1*s.* 1½*d.* which nearly corresponded with the principle above stated: but the average price of a peck of oatmeal, in 1810, was 1*s.* 3¾*d.* whilst the average price of a day's labour was 1*s.* 10½*d.* which shews, in a most satisfactory manner, the very great improvement that has taken place, in the lot of the labouring classes, in that part of the united kingdom*.

6. *The practice of giving Labourers Grain, &c. at a cheap Rate.*—In order to compensate for the low rate of labour, compared to the increased price of provisions, His late Majesty, (George III.) who carried on farming operations to a considerable extent, adopted the plan of allowing his labourers flour at a fixed price, whatever wheat might sell for. This benevolent system, has been imitated by several gentlemen farmers, some of whom have allowed bread, and others a daily quantity of milk, at moderate prices†. The same system is general in several of the western counties, as in Dorset, Devon, and Cornwall, where the labourers have a standing supply of bread-corn;—of wheat at 6*s.* and of barley at 3*s.* per bushel‡.

7. *Effects of High Wages.*—In the wages of labour, as well as in every thing else, moderation is desirable. It is remarked, that high wages have a tendency to throw labourers out of employment, as farmers in general, and even small proprietors, are unable to give such wages; hence they are obliged to carry on their work with fewer hands, or to postpone improvements, which otherwise they would have undertaken. Nor is that all. The labourers themselves suffer by it, and so does the public. In the fens of Lincolnshire, wages have risen in harvest time, from 3*s.* 6*d.* to 7*s.* nay to 10*s.* 6*d.* per day, every day's hiring, taking place at a certain spot, where masters, whose work is in haste, outbid each other, and thus raised the wages to that exorbitant height. The consequence was, that the labourers got drunk, would not work above four days out of the six,

* General Report of Scotland, vol. iii. p. 262. The wages of *hinds*, or married ploughmen, have greatly increased. In 1792, they only received thirteen bolls of grain, but it has since been augmented to seventeen bolls, or at the rate of thirty per cent.

† Bedfordshire Report, p. 415.

‡ Dorset Report, p. 439; Devon, p. 365; and Cornwall, p. 159. In Dorset, malt and hops are given to the cottagers, to brew ale for the use of their families, in hay time and harvest.

dissipated their money,—hurt their constitutions,—contracted indolent and vicious habits,—and their labour was lost to the community, for at least one-third part of the time, at a most important crisis.*.

8. *On training Labourers to Activity and Diligence.*—It is of great importance, to train labourers employed in agriculture, to activity and diligence. In some districts, they are proverbial for the slowness of their step, which they teach their horses, whereas, these animals, if accustomed to it, would move, with as much ease to themselves, in a quick, as in a slow pace. Hence their ploughs seldom go above two miles in an hour, and sometimes even less; whereas where the soil is light and sandy, they might go at the rate of three miles and a half. Farmers are greater sufferers than they imagine, by this habitual indolence of their workmen, which extends, from the plough, to all their other employments†, for it makes a very important difference in the expence of labour. Where the land however is stiff, and deep ploughing is necessary, the operation ought not to be too much hurried.

Sect. VI.—*Live Stock.*

By far the largest proportion of the territory of almost every country, is devoted to the breeding and support of live stock. In early ages, these formed the only criterion of wealth. They became of less consequence, when the culture of grain was first introduced; but their importance afterwards, as the instruments of cultivation, as the means of supplying a large proportion of our food, and as furnishing a variety of our most essential accommodations, tends to render this branch of the inquiry, peculiarly interesting.

In discussing this subject, *a few general remarks*, shall only be offered: 1. On the most desirable properties of live stock; 2. On the principles of improved breeding; and, 3. On the management of stock. To enter fully into details regarding these particulars, would require a volume of no inconsiderable dimensions‡.

* Lincolnshire Report, p. 445, note. † Wilts Report, p. 212.

‡ The various particulars connected with the management of live stock, are probably still more numerous than those which belong to the raising of the several crops, and the cultivation of the different kinds of land under the

1. *On the most desirable Properties of Live Stock.*

Under the general term *live stock*, are comprehended, the various sorts of domesticated animals, which are employed by man as instruments, for assisting him in labour, or converting to his use, those productions of the soil, which are not immediately applicable, to supply his wants, in their natural state*. Bakewell expressed the same idea, when he described live stock, as machines, for converting herbage, and other food for animals, into money. But money, in fact, is only the sign of wealth, while live stock are real riches.

The most desirable properties of live stock, may be considered under the following heads: 1. Size; 2. Form; 3. A tendency to grow; 4. Early maturity; 5. Hardiness of constitution; 6. Prolific properties; 7. Quality of flesh; 8. A disposition to fatten; and, 9. Lightness of offal. The following observations on these points are principally applicable to animals destined for food.

1. *Size.*—Before the improvements introduced by Bakewell, the value of an animal was entirely judged of by its bulk; and if a great size could be obtained, more regard was paid, to the price the animal ultimately fetched, than to the cost of its food. Of late, since breeders began to calculate with more precision, small, or moderate-sized animals, have been generally preferred, for the following reasons:

1. Small-sized animals are more easily kept; they thrive on shorter herbage, they collect food, where a large animal could hardly exist, and thence are more profitable†. 2. Their meat is finer grained, produces richer gravy, has often a superior flavour, and is commonly more nicely marbled, or veined with fat, especially when they have been fed for two years‡. 3. Large animals are not so well calculated for general consumption, as the moderate sized, particularly in hot weather. 4. Large animals poach pastures more than small

care of husbandmen; (Coventry's Discourses, p. 134), and would consequently require a more extensive inquiry.

* General Report of Scotland, vol. iii. p. 2.

† In regard to small-sized sheep, see Dr. Parry's Essay on the Merino sheep; Communications to the Board of Agriculture, vol. v. p. 460. By breeding small sheep instead of large ones, the number was increased, on the ground of a farmer who tried the experiment, from 660 to 890 ewes and lambs, and the profit from 450*l.* to above 724*l.*—*Ditto*, p. 461. They should not, however, be under their pasture, nor of a small sort, on rich land.

‡ The *marbling* of meat must in a great measure depend on the age of the animal. When full grown, the Highland Scots have been fed to perfection in Norfolk, in even eight months.

ones. 5. They are not so active, require more rest, collect their food with more labour, and will only consume the nicer, and more delicate sorts of plants. 6. Small cows, of the true dairy breeds, give proportionately more milk than large ones. 7. Small cattle may be fattened solely on grass, of even moderate quality; whereas the large, require the richest pastures, or to be stall-fed, the expence of which exhausts the profit of the farmer. 8. It is much easier to procure well-shaped, and kindly-feeding stock of a small size, than of a large one. 9. Small-sized cattle, may be kept by many persons, who cannot afford, either to purchase, or to maintain large ones; and by whom the loss, if any accident should happen to them, can be more easily borne. 10. The small-sized sell better; for a butcher, from a conviction that, in proportion to their respective dimensions, there is a greater superficies of valuable parts in a small, than in a large animal, will give more money for two oxen of twelve stone each per quarter, than for one of twenty-four stone.

In favour of the large-sized, it is on the other hand contended, 1. That without debating whether from their birth, till they are slaughtered, the large or the small one eats most for its size, yet on the whole, the large one, will pay the grazier or farmer who fattens him, as well for its food. 2. That though some large oxen are coarse grained, yet, where attention is paid to the breed, (as is the case with the Herefordshire), the large ox is as delicate food as the small one. 3. That if the small-sized are better calculated for the consumption of private families, of villages, or of small towns, yet that large cattle, are fitter for the markets of great towns, and in particular of the metropolis. 4. That were the flesh of the small-sized ox, better, when fresh, yet the meat of the large-sized is unquestionably more calculated for salting, a most essential object in a maritime and commercial country, for the thicker the beef, the better it will retain its juices when salted, and the fitter it is for long voyages. 5. That the hide of the large ox is of very great consequence in various manufactures. 6. That large stock are in general distinguished by a greater quietness of disposition. 7. That where the pastures are good, cattle and sheep will increase in size, without any particular attention on the part of the breeder; large animals are naturally therefore the proper stock for such pastures. 8. That the art of fattening cattle, and even sheep, with oil-cake, being

much improved and extended, the advantage of that practice would be of less consequence, unless large oxen were bred, as small oxen can be fattened with grass and turnips, as well as oil-cake; and lastly, that large oxen are better calculated for working than small ones, two large oxen being equal to four small ones in the plough or the cart.

Such are the arguments generally made use of on both sides of the question; from which it appears, that much must depend upon pastures, taste, mode of consumption, markets, &c. and that both sizes have their advantages. The intelligent breeder, however, (unless his pastures are of a nature peculiarly forcing), will naturally prefer a moderate size, in the stock he rears.

The late Mr. Davis of Longleat, one of the ablest agriculturists this country has produced, has given some useful observations on the subject of size. He laments, that the attempts which have been made to improve the breeds of cows, horses, and sheep, have proceeded too much upon the principle *of enlarging the size of the animal;* whereas, in general, the only real improvement has been made in the pig, and that was, by reducing its size, and introducing a kind that will live hardier, and come to greater perfection at an earlier age*. His objections indeed to the using of large heavy-heel'd horses, in preference to the smart, the active, and the really useful breeds, merit particular attention. In some situations, the steepness of the hills, and the heaviness of the soil, require more than ordinary strength; but in such cases, he maintains, that it would be better to add to the number of horses, than to increase their size. Great horses not only cost proportionably more at first than small ones, but require much more food, and of a better quality, to keep up their flesh. The Wiltshire carter also, takes a pride in keeping them as fat as possible; and their food, (which is generally *barley*†), is given without stint. In many instances, indeed, the expence of keeping a fine team of horses, amounts to nearly the rent of the farm on which they are worked. They are purchased young when two years old colts, and sold at five or six years of age, for the London drays and waggons. The expence of their maintenance is very seldom counterbalanced

* Wiltshire Report, p. 155.

† This is a practice which the Norfolk farmer should partly adopt; and indeed the importation of oats ought to be prohibited, as barley would answer as well as food for horses, more especially with a mixture of Swedish turnips.

by the difference of price, more especially as such horses are gently worked when young, that they may attain their full size and beauty. In ploughing light soils, the strength of a dray horse is not wanted; and in heavy soils, the weight of the animal does injury to the land*.

2. *Form.*—Though it is extremely desirable, to bring the shape of cattle to as much perfection as possible, yet profit and utility ought not to be sacrificed for mere beauty, which may please the eye, but will not fill the pocket†; and which, depending much upon caprice, must be often changing.

In regard to form, the most experienced breeders seem to concur in the following particulars: 1. That the form or shape should be compact, so that no part of the animal should be disproportioned to the other parts; and the whole distinguished by a general fulness and rotundity of shape; 2. That the chest should be broad; for no animal whose chest is narrow, can easily be made fat‡; 3. That the carcass should be deep and straight; 4. That the belly should be of a moderate size; for when it is more capacious than common, in young animals, it shews a diseased state, and in older ones, it is considered a proof, that the animal will not return in flesh, in milk, or in labour, the value of the extra quantity of food which it consumes§; 5. That the legs should be short, for the long-limbed individuals of the same family or race, are found to be the least hardy, and the most difficult to rear or to fatten; and, 6. That the head, the bones, and other parts of inferior value, should be as small as is consistent with strength, and with the other properties which the animal ought to possess. In animals bred for the shambles, the form must likewise be such, as to contain the greatest possible proportion of the finer, compared to the coarser and less valuable parts of the

* Wiltshire Report, p. 152.—It may thence be asserted with justice, that the benefit the Wiltshire farmers derive from their excellent markets, are not commensurate with the expence of maintaining these fine horses, to carry the grain they send to them.

† The late intelligent Mr. Davis, of Longleat, lamented that the Wiltshire farmers had that "*pride of stock*," which induced them to prefer beauty and size, to utility and profit.—*Wiltshire Report*, p. 203.

‡ Sir John S. Sebright's Letter to Sir Joseph Banks, p. 22.

§ Bedfordshire Report, p. 572.—All the fine breeds have a much less bulk of intestines, and a smaller intestinal canal, than the inferior stock, which is attributed to this, that getting rich food in early life, containing much nourishment, in a small bulk, the parts are not so distended, as they would have been with coarser fare.—*Coventry's Discourses*, p. 165.

animal. This, by selection, may be attained; and thus the wishes of the consumer may be gratified. As to the broad loins, and full hips, which are considered as a point of excellence in particular breeds, it is evident, that the old narrow, and thin make required improvement; but the alteration is now carried to a faulty excess, and often occasion great difficulty and danger in calving*.

The form of animals, has fortunately attracted the attention of an eminent surgeon, (Henry Cline, Esq. of London), the substance of whose doctrines is: 1. That the external form is only an indication of the internal structure; 2. That the lungs of an animal is the first object to be attended to, for on their size and soundness, the health and strength of an animal principally depend; 3. That the external indications of the size of the lungs, are the form and size of the chest, and its breadth in particular†; 4. That the head should be small, as by this, the birth is facilitated;—as it affords other advantages in feeding, &c.—and as it generally indicates that the animal is of a good breed; 5. That the length of the neck should be in proportion to the size of the animal, that it may collect its food with ease; and, 6. That the muscles and tendons should be large, by which an animal is enabled to travel with greater facility.

It was formerly the practice, to estimate the value of animals by the size of their bones. A large bone was considered to be a great merit; and a *fine boned* animal, always implied great size. It is now known, that this doctrine was carried too far. The strength of an animal does not depend upon the bones, but on the muscles; and when the bones are disproportionably large, it indicates, in Mr. Cline's opinion, an imperfection in the organs of nutrition‡. Bakewell strongly insisted on the advantage of small bones; and

* Coventry's Discourses, p. 175, note.

† These *anatomical rules*, as they are called, have been objected to. It is said, that a broad-chested horse, is seldom a good hackney; that in a blood horse, it is desirable, that his chest should be lean, and rather tight to the eye; that a broad-chested ox is often light in the flank; and that broad and well spread shoulders, indicate a good ox, more than width between the fore-legs. These, however, are only exceptions to a general rule. In regard to sheep in particular, an expanded chest, and the thorax having ample room for the free play of the heart and lungs, is the characteristic mark of health and vigour in the animal.—*Doctor Rigby's Report*, p. 25.

‡ See the paper by Henry Cline, Esq. "On the Form of Animals," Communications to the Board of Agriculture, vol. iv. p. 440.

the celebrated John Hunter declared, that small bones were generally attended with corpulence, in all the various subjects he had an opportunity of examining. A small bone, however, being heavier and more substantial, requires as much nourishment as a hollow one, with a larger circumference*.

3. *A tendency to grow.*—Among the qualities for which thorough-bred cattle and sheep are distinguished, that of being *good growers*, and having a good length of frame, is not the least essential. The meaning of which is, that the animal should not only be of a strong and healthy constitution, but speedily should grow to a proper size. As specimens of rapid growth, a steer of three years old, when well fed, will weigh from 80 to 90 or 100 stone, 14 lb. to the stone; and a two-year old Leicester wedder, from 25 to 28 lb. per quarter, immediately after his second fleece is taken from him. Animals having the property *of growing*, are usually straight in their back and belly; their shoulders well thrown back, and their belly rather light than otherwise. At the same time, a gauntness and paucity of intestines should be guarded against, as a most material defect, indicating a very unthrifty animal. Being *too light of bone*, as it is termed, is also a great fault. A good grower, or hardy animal, has always a middling sized bone. A bull distinguished for getting good growers, is inestimable; but one whose progeny takes an unnatural or gigantic size, ought to be avoided†.

4. *Early Maturity.*—Arriving soon at perfection, not only in point of *growth* or size, but in respect of *fatness*, is a material object for the farmer, as his profit must in a great measure depend upon it. Where animals, bred for the carcass merely, become fat at an early age, they not only return sooner the price of their food, with profit to the feeder, but in general also, a greater value for their consumption, than slow-feeding animals‡. This desirable property greatly depends on a mild and docile disposition; and as this docility of temper is much owing to the manner in

* Small bones, like those of the blood horse, are compact and heavy; large bones, like those of the common dray or cart horses, are extremely porous, and consequently light for their apparent bulk.

† Husbandry of Scotland, vol. ii. Appendix, p. 112.

‡ General Report of Scotland, vol. iii. p. 6. Two calves kept and fed alike, one of the improved breed, the other of the common unimproved stock of the country; the first got fatter, and fitter for the butcher at two years old, than the other did at three.—*Durham Report*, p. 236.

which the animal is brought up, attention to inure them early to be familiar, cannot be too much recommended. A tame breed also has other advantages. It is not so apt to injure fences, or to break into adjacent fields; consequently it is less liable to accidents, and can be reared, supported, and fattened, at less expence. The property of early maturity, in a populous country, where the consumption of meat is great, is extremely beneficial to the public, as it evidently tends to furnish greater supplies to the market; and this propensity to fatten at an early age, is a sure proof, that an animal will fatten speedily at a later period of his life.

5. *Hardiness of Constitution.*—In the wilder and bleaker parts of a country, the possession of a hardy and healthy constitution, is a most valuable property in stock. Where the surface is barren, and the climate rigorous, it is essential that the stock bred and maintained there, should be able to endure the severities and vicissitudes of the weather, as well as scarcity of food, hard work, or any other circumstance in its treatment, that might subject a more delicate breed to injury. In this respect, different kinds of stock greatly vary; and it is a matter of much consequence, to select, for different situations, cattle with constitutions suitable to the place where they are to be kept*. It is a popular belief, that dark colours are indications of hardiness. In mountain breeds of cattle, a rough pile is reckoned a desirable property, more especially when they are to be kept out all winter. It enables them to face the storm, instead of shrinking from it†. Hardy breeds are exempted from various diseases, as having yellow fat‡, also being *lyery*, or blackfleshed, defects so injurious to stock§.

6. *Prolific Quality.*—By this property is meant, that the females of a breed, both bear more frequently than usual, and also have frequently more than one at a birth. This property runs more strikingly in sub-varieties, or individual families; and though partly owing, to something in the

* Coventry's Discourses, p. 179. The same intelligent author justly remarks, that the breeds distinguished by early maturity, do not seem calculated for districts, where the climate is cold, and the food is poor and scanty. Hence it is not improbable, that a slow-growing animal, capable of being sustained on coarser fare, may prove ultimately more profitable in such a district, more especially in cases where richer food is expensive, or acquired with difficulty. Ditto, p. 177.

† It is remarked in the Highlands, that in bad weather, hardy cattle keep their back bones straight, whereas the more delicate sort set up a hog back. Hence the crooked appearance of bad cattle.

‡ Middlesex Report, p. 576.

§ Culley on Live Stock, second edition, p. 48.

habits of animals, and partly to their previous good or bad treatment*, yet in some degree, seems to depend upon the seasons, some years being more distinguished for twins than others. In breeding, not only the numbers, but the sex of the offspring, in some cases, seem to depend upon the female parent. Two cows produced fourteen females each in fifteen years, *though the bull was changed every year.* It is singular, that when they produced a bull calf, it was in the same year. Under similar circumstances, a great number of males have been produced by the same cow in succession, but not to the same extent†.

7. *Quality of Flesh.*—Breeds are likewise distinguished by the quality of their flesh. In some kinds it is coarse, hard, and fibrous;—in others of a finer grain or texture. In some breeds also, the flavour of the meat is superior;—the gravy they produce, instead of being white and insipid, is high coloured, well flavoured, and rich;—and the fat is intermixed among the fibres of the muscles, giving the meat a streaked, or marbled appearance. Breeds whose flesh have these properties, are peculiarly valuable. Hence two animals of nearly the same degree of fatness, and weight, and who could be fed at nearly the same expence to the husbandman, will sell at very different prices, merely from the known character of their meat‡.

8. *A disposition to Fatten.*—This is a great object in animals destined for the shambles. Some animals possess this property during the whole progress of their lives, while in others, it only takes place at a more advanced period, when they have attained their full growth, and are furnished at the same time with a suitable supply of food. There are in this respect other distinctions: 1. Most sorts of cattle and sheep, which have been bred in hilly countries, will become fat on lowland pastures, on which the more refined breeds would barely live; and, 2. Some animals take on fat very quickly, when the proper food has been supplied, and some individuals have been found, even in the same breed, which have, in a given time, consumed the least proportional weight, of the same kind of food, yet have become fat at the quickest rate. Even in the human race, with little food,

* Coventry's Discourses, p. 183.

† Answers to Querics, by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 204.

‡ Coventry's Discourses, p. 175. Culley on Live Stock, second edition, p. 43. The quality of the flesh, is much more attended to in the English than in the Scotch markets.

some will grow immoderately corpulent. It is probably from internal conformation, that this property of rapid fattening is derived*.

The advantages and disadvantages of fattening cattle and sheep, at least to the extent frequently practised at present, are points that have of late attracted much public attention. But any controversy on that subject, can only arise from want of proper discrimination. Fat meat is unquestionably more nourishing than lean, though to digest this oily matter, there are required, on account of its difficult solubility, a good bile, much saliva, and a strong stomach; consequently none, excepting those who are in the most vigorous state of health, or who are employed in hard labour, can properly digest it†. Though fat meat, however, is unfit for general consumption, yet experiments in the art of fattening animals, are likely to promote useful discoveries; and, though, in the course of trying a number of experiments, errors and excesses may be committed, yet on the whole, advantage may be derived from the knowledge thus to be obtained‡. As the bone also gains but little in the fatting animal, and the other offal becomes proportionably less, as the animal becomes more fat, the public has not sustained much loss by over-fatted animals. To kill even hogs till they are thoroughly fat, is exceeding bad economy. An ox or cow, though the little flesh it has may be of good quality, yet presents, when lean, little but skin and bone; and if slaughtered in that state, would neither indemnify the owner for the expence of breeding and maintaining it, nor benefit the public. A coarse and heavy-fleshed ox, which would require a very long time, and much good food to fatten, may be slaughtered with most advantage, while rather lean. It is not, however, so much the extent of fat, as the want of a sufficient quantity of lean flesh, of which the consumer complains; for it cannot be doubted, that the lean flesh of a fat animal, is superior in quality, and contains more nourishment, than any other meat§.

* Coventry's Discourses, p. 177, &c.

† Willich's Lectures on Diet and Regimen, third edition, p. 316.

‡ Hints regarding Cattle, from Essays on Miscellaneous Subjects; by Sir John Sinclair, Bart. p. 74.

§ See Answers to Queries regarding Live Stock, by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 108. Dr. Stark's experiments go to prove, that three ounces of boiled fat beef are equal, in point of nutrition, to a pound of lean. See a tract printed an. 1801, entitled "*Practical Economy*," &c.

Here it may be proper to mention, that indication of a tendency to fatten, which is technically called *handling well.* The graziers and butchers in various parts of the kingdom, had recourse to the hand, and the feeling of the skin, or cellular membrane, for ascertaining a disposition to fatten*; but since Bakewell directed the public attention so much to breeding, that practice has become more generally known. Handling cannot easily be defined, and can only be learnt by experience. The skin and flesh of cattle, when handled, should feel soft to the touch, somewhat resembling that of a mole, but with a little more resistance to the finger. A soft and mellow skin must be more pliable, and more easily stretched out, to receive any extraordinary quantity of fat and muscle, than a thick or tough one. The rigid-skinned animal, must therefore always be the most difficult to fatten. In a good sheep, the skin is not only soft and mellow, but in some degree elastic. Neither cattle nor sheep can be reckoned good, whatever their shapes may be, *unless they are first-rate handlers*†.

The improved short-horned breed, besides their mellowness of skin, are likewise distinguished by softness and silkiness of hair. Too great a length, however, ought not to be aimed at, since it is not easy, in that case, to preserve a due proportion in the appearance of the animal, without which it cannot be considered perfect‡.

9. *Lightness of Offal.*—It is also of much importance, that an animal solely bred for the shambles, should have as little *offal*, or parts of inferior value as possible, (consistently with the health of the animal), and consequently a greater proportion of meat applicable as food for man§.

* Young's Lecture on the Husbandry of Three Celebrated Farmers, p. 10. Mr. Mason's Letter to Sir John Sinclair, Farmer's Magazine, vol. xv. p. 60. It appears from Columella's description of the best kind of ox, that the advantage of a soft skin is not a new discovery, but was perfectly well known to the husbandmen of ancient Italy.

† Husbandry of Scotland, vol. ii. Appendix, p. 110. This is the *technical expression*, though properly speaking, the man is the handler, and the skin of the beast is handled. We are apt to say, in the same manner, that a horse *rides* well.

‡ See Mr. Robert Colling's Letter to Sir John Sinclair, Farmer's Magazine, vol. xv. p. 61.

§ The great perfection of an animal is, when the dead weight of all the eatable parts, approaches the nearest to the weight of the animal when alive. The following statement of the live and dead weight of a Devonshire

II. *On the Principles of Improved Breeding.*

The art of improved breeding consists, in making a careful selection of males and females, for the purpose of producing a stock, with fewer defects, and with greater properties than their parents; by which their mutual perfections shall be preserved, and their mutual faults corrected*.

The objects of improved breeding, therefore, are, to obviate defects, and to acquire and to perpetuate desirable properties; hence, when a race of animals have possessed, in a great degree, through several generations, the properties which it is our object to obtain, and any tendency to

ox, aged three years and ten months, will explain the manner in which these accounts are drawn up.

			Stone.
Live weight			114
	Offal.	*Stone.*	*lb.*
Tallow		10	6
Hide		6	3
Head and tongue		2	9
Heart, liver, and lungs		2	7
Feet		1	4
Entrails and Blood		11	13
			35
Butcher's meat, the carcass or four quarters			79
			114

This proved to be a prime ox, as his beef or available food, weighed three stone *more* than *two-thirds* of his live weight. It likewise appears in this case, that 10 stones of live weight, produced 6 stones 13 lbs. of dead weight, or butcher's meat. *Durham Report*, p. 239.—The average of other experiments is, from 6 stone 10 lbs. to 6 stone 13½ lbs. of dead weight, to 10 stone of live weight. When an ox is fed for two years in succession, a much higher proportion of dead weight is the result, though it hardly ever exceeds three-fourths of the live weight, or as 15 is to 20.

In sheep, on an average, from 10lb. of living weight, 6 lb. 7 ounces of dead weight, convertible into food, may be obtained.—*Durham Report*, p. 251; consequently, in this respect, cattle are superior to sheep.

* Sir John S. Sebright's Essay on the Art of Improving the Breed of Domestic Animals, p. 5 and 8.—All breeding proceeds on the presumption, that the tendency of any individual animal is, to transmit to its offspring, the form, constitution, and qualities which it possesses; and as two animals are concerned in the production of one offspring, that one is expected to inherit, a form and constitution, compounded on the joint qualities of its two parents. Thus it is found, in numerous breeds of animals, as in deer,—in the West Highland cattle,—in the North Devon,—and in the Wild cattle of Chillingham Park: the offspring, for an indefinite number of generations, have borne the same general characters.—*Observations by C. Mason, Esq. of Clifton, Co. Durham.*

produce unwished for properties, has been extirpated, their progeny are said to be *well-bred*, and their stock may be relied on*.

It was upon this principle of selection, that Bakewell formed his celebrated stock of sheep, having spared no pains or expence, in obtaining the choicest individuals, from all the best kinds of long or combing woolled sheep, wherever they were to be met with†; and it cannot be doubted, that any breed may be improved in the same manner, namely, that of putting the best males to the finest females. After a superior breed, however, has thus been obtained, it is a point that has been much disputed, whether it is proper to raise stock, 1. From the same family; or, 2. From the same race, but of different families; or, 3. From races entirely different.

1. *Breeding from the same Family.*—This method is called breeding *in-and-in*, or putting animals of the nearest relationship together‡. Though this plan was for some time in fashion, under the sanction of Bakewell's authority, yet experience has now proved, that it cannot be successfully persevered in. It may prove beneficial indeed, if not carried too far, in fixing any variety that may be thought valuable§, but on the whole, it is so only in appearance. Under this system, the young animal comes into the world, on, comparatively, a very small scale. By keeping it fat from the first moment of its existence, it is made to attain a greater size than nature intended; and its weight in consequence will be very great, in proportion to the size of its bones. Thus a generation or two of animals of an extraordinary form, and saleable at enormous prices, may be obtained; but that does not prove that the practice is eligible, if long persisted in‖. On the contrary, if the system be followed up, the stock get tender and delicate, they become

* Sir John S. Sebright's Essay, p. 7. Incessant care and attention, however, are necessary, to keep them up to the mark; and this is rather fortunate than otherwise, since it perpetuates the *merit* of breeders, and the competition of stock.

† Young's Lecture, p. 9.

‡ It having been found, that this system produced animals quite deficient in vigour, those who are now possessed of a capital stock, keep two or three *streams of blood*, quite distinct, that they may avoid a consanguinity.

§ Sir John S. Sebright's Essay, p. 13. Paper by Henry Cline, Esq. Comm. vol. iv. p. 442.

‖ Paper by T. A. Knight, Esq. Comm. to the Board of Agriculture, vol. ii. p. 185. These dwarfish males, however, may not have an injurious effect on the stock of another person, especially the first cross, if the females be of a coarser quality, and, on Mr. Cline's principle, if they are of a larger size than the males put to them.

bad feeders; and though they retain their shape and beauty, they will decrease in vigour and activity, will become lean and dwarfish, and ultimately incapable of continuing the race. The instances of this are numerous. The celebrated breeder, Prinsep, found, that decrease of size unavoidable, in spite of all his endeavours, by keeping his young stock well, to prevent it*. Sir John S. Sebright tried many experiments by breeding *in-and-in*, with dogs, fowls, and pigeons, and found the breeds uniformly degenerate†. A gentleman who tried the system with pigs, brought them at last into such a state, that the females gave over breeding almost entirely, and when they did breed, their produce was so small and delicate, that they died as soon as they were born. Nay, Mr. Knight's experience with plants have fully convinced him, that in the vegetable, as well as in the animal kingdom, the offspring of a male and female, not related, will possess more strength and vigour, than where they are both of the same family‡. This proves how unprofitable such connexions are. That is no reason, however, why a breeder may not manage a particular family of animals to great advantage, by shifting or changing, instead of breeding directly from parents to offspring§. Hence the propriety of procuring males, from the flocks and herds of those who have the same, or a similar breed. It has been remarked, that those farmers have in general the worst flocks, who breed from rams produced on their own farms, and that an interchange of males, is mutually beneficial‖.

With respect to the doctrine, " that when you can no longer find better males than your own, then by all means breed from them, for that best can only beget best;" it is ably refuted by an intelligent author, who has devoted much attention to the art of breeding. He observes, that there never did exist an animal, without some defect in constitution, in form, or in some other essential quality; and such defect, however small it may be at first, will increase in every succeeding generation, and at last predominate in such

* Paper by T. A. Knight, Esq. Comm. to the Board of Agriculture, vol. ii. p. 185.

† Sir John S. Sebright's Essay, p. 13.

‡ Paper by T. A. Knight, Esq. Comm. to the Board of Agriculture, vol. ii. p. 186.

§ Husbandry of Scotland, vol. ii. Appendix, p. 109. The same rule holds good regarding the human species. By a train of unfortunate circumstances, a brother and sister German, ignorant of their close connexion together, were married. They had ten children, all of whom died before their parents.

‖ Paper by T. A. Knight, Esq. Comm. vol. ii. p. 172.

a degree, as to render the breed of little value*. Breeding *in-and-in*, therefore, would only tend to increase, and to perpetuate that defect, which might be eradicated, by a judicious selection, from a different family, in the same race.

2. The breeding from different families, of the same race, is therefore a preferable system. When these have been for some time established in different situations, and have had some slight shades of difference impressed upon them, by the influence of different climates, soils, and treatment, it is found advantageous, to interchange the males, for the purpose of strengthening the excellencies, and remedying the defects of each family. On this principle, the celebrated Culley continued, for many years, to hire his rams from Bakewell, at the very time, that other breeders were paying him a liberal price for the use of his own; and the very same practice is followed by the most skilful breeders at present†.

3. Any attempt at improvement, *by crossing* two distinct breeds or races, one of which possesses the properties which it is wished to obtain, or is free from the defects which it is desirable to remove, requires a degree of judgment and perseverance, to render such a plan successful, as is very rarely to be met with. Indeed, though such crosses may, by great attention, answer at first, yet, it is generally found, that great singularities attend such mixtures; and, in breeding bulls, though some of them may apparently do, yet their breed is not to be trusted. The first cross between a good short-horned bull, and a good Kyloe cow, will make a good grazing animal; but by proceeding farther, disappointment will ensue, if a regular stock be wanted. If such a cross is to be persevered in, the male should always be of the same breed with the first‡.

Crossing with larger males from another country, is sometimes attempted, with a view of enlarging the size of stock. But such attempts should be made with the greatest caution; for by a mistaken practice, extensively pursued, irreparable mischief may be effected. Where a particular race of animals has continued for centuries, it may be presumed, that their constitution is adapted to the soil and climate. Any attempt, therefore, to increase the size of a native race of animals, without improving their food, by which their size

* Sir John S. Sebright on Improving the Breeds of Domestic Animals, p. 11 and 14.

† General Report of Scotland, vol. iii. p. 17.

‡ Husbandry of Scotland, vol. ii. Appendix, p. 109.

is regulated, is a fruitless effort to counteract the laws of nature. In proportion to their increase of size, by crossing, they become worse in form, less hardy, and more liable to disease*. The only satisfactory, and judicious mode, of enlarging the size of any race of animals is, by maintaining better the original stock of the country, more especially during their youth. In every case, where the enlargement of the carcass is the object, the cross breed must be better fed than the native parent. Hence, if a good stock can be otherwise obtained, crossing ought to be avoided; for it produces a species of mongrel; and it is more difficult to get rid of the imperfections thus introduced into a breed, than is commonly imagined†.

The eminent surgeon already alluded to, (Henry Cline, Esq.), is of opinion, that any improvement of form by crossing, must entirely depend, on selecting a well-formed female, larger in size than the usual proportion between females and males‡. The fœtus will thus be better nourished, which is so essential to the production of an animal with the most perfect form. Abundant nourishment is necessary, from the earliest period of its existence, until its growth is complete. Upon this principle, the breed of English horses were improved, by crossing them with diminutive stallions, Barbs, and Arabians. The celebrated Clydesdale breed of horses in Scotland, originated from the introduction of some large Flanders mares into that country; and our hogs have been improved, by crossing with small Chinese boars. Other experiments on the same principle, have also succeeded. Mr. Spearman, a farmer in Northumberland, tried a cross between the Kyloe or Highland bull, and the large short-horned cow; and during the experience of twenty years, found it to answer. The plan recommended by Mr. Cline, has likewise been most successfully practised by M. Vander-

* Paper by Henry Cline, Esq. Communications to the Board of Agriculture, vol. iv. p. 445. This appears to be an important rule.

† A single cross, without breeding from either the males or the females thus produced, is often more profitable, than the pure breed; but if the crossing is continued, many inferior animals will be found in a flock. Hence it is, that improving a breed already established, by judicious selection, is to be preferred with a view to permanent advantage.

‡ Mr. Cline's doctrine has been much misunderstood. He does not require that the female should be larger than the male, but larger in size, *than is usually the proportion* between females and males. Communications to the Board of Agriculture, &c. vol. iv. p. 440. Where the female is too small, or the male too large, the offspring is generally ill-shaped. A gentleman in Forfarshire rears an excellent breed, by crossing the large Angus cows, with a small Highland bull from Lochaber.

goes, near the Hague, who has perhaps the finest stock of dairy cows in Holland. The excellence of his breed, he entirely attributes to his using none but young bulls, who have not attained their full growth or size, and which he always parts with at three years of age.

The improvement of the fleece depends, however, upon the male; it being proved, that in the course of four or five generations, using always the Merino ram, fleeces rivalling the Spanish may be obtained, from ewes of British stock*.

In regard to the period of commencing breeding, a cow in general, should not produce a calf, at an earlier period than three years old. A bull may be first used at fourteen or eighteen months. He then shews most vigour, and more energy may be expected in his produce. At two or three years old, they frequently become ungovernable, and are killed†. Many contend, that the offspring of a bull, if well bred, becomes generally better till he reaches seven or eight years, and indeed till his constitution is impaired by age‡. This doctrine, however, does not agree with the practice of Mr. Vandergoes in Holland; nor can the question be finally decided, without a regular course of experiments. In breeding sheep, the age of the ram is not considered to be a point of much importance.

Some breeders maintain, that the offspring take considerably more after the male, than the female parent§. It is believed, however, that some parts of the offspring take after the male, and some after the female. If the female be small, and such a habit be permanent in her family, the length of the legs of the offspring, will seldom be influenced by the male, but much by the female parent in the womb, and will not subsequently change. The width and depth, and consequently the weight of carcass, will be greatly influenced by the male; and if it be of a large kind, the offspring will present great weight in a small compass. This has been proved by crossing a West-Highland cow, with a Herefordshire bull, not with a view of continuing the breed, but to dispose of all the animals produced by the cross. The offspring have the short legs of the West-Highland cow, with the increased

* Dr. Parry's Paper, in the Communications to the Board of Agriculture, vol. v. p. 339.

† Communications to the Board of Agriculture, vol. ii. p. 178.

‡ Answers by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 104.

§ Letter from Mr. Robert Colling to Sir John Sinclair, Farmer's Magazine, vol. xv. p. 61.

weight that might be expected from a Hereford bull. They are exceedingly hardy, their flesh is of excellent quality, and they have, at two years old, nearly the proportions of other stock at six. The females are consequently ready to be fatted at two years old. The males require to be one year older*. The crossing the Herefordshire heifer, however, with a West-Highland bull, would answer better, were the formation of an entire new breed to be attempted.

Among the rules of breeding, one is, that the young should be brought forth at the season of the year, when there is usually a full supply of suitable food. This is particularly necessary to be attended to, on high and exposed situations, where there is little, or no other provision than common pastures. Where this rule has not been adverted to, great losses have been sustained†. It is necessary at the same time to guard against an opposite extreme, and to take care that the birth shall not be so late in the season, that there shall be any risk of the young animal being unable to bear the cold, and severities of the ensuing winter‡.

Another rule in breeding is, never to fix on the ewes to be put to a favourite ram, until the lambs got by him, the preceding year, have been examined. The perfections and defects of his progeny, are thus ascertained, and ewes are given him accordingly. By such attention, and carefully selecting from the lambs, rejecting all doubtful ones, a flock is kept in a constant state of progressive improvement§.

A third rule is, in selecting a male from a small number, not to chuse the weakest male, though it may possess the most delicate form, and approach the nearest to female symmetry; for if the same system were to be continued for a few generations, it may easily be supposed, that such a breed will dwindle, compared to one, left to the process of nature, in which the strongest males, driving off the weakest, are exclusively employed for the propagation of the kind||.

It is farther necessary to observe, that any defect in a breed, will not only be transmitted uncorrected, but will necessarily increase in the progeny; a tendency to that defect, being inherited by both parents, and both being imme-

* Answers by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 104 and 105.

† General Report of Scotland, vol. iii. p. 21.

‡ Coventry's Discourses, p. 160.

§ This was the practice of the late Duke of Bedford.—*Young's Calendar*, p. 511.

|| Remark by C. Mason, Esq. of Clifton.

diately descended from its original propagator. This defect may be in respect of size, form, inclination to feed at an early age, to feed fat with a comparatively small consumption of vegetable food, to lay that fat on valuable points, or in constitutional health; and according to the nature of the original defect, the breed will become bad feeders, or incapable of producing any but an unhealthy offspring.

On this branch of the subject, it may be proper to add, that the justly celebrated Bakewell, was the father of the improved system of breeding. He was, by nature, a strong-minded man, and a superior judge of stock for the times in which he lived. Experience, however, has since made the art more perfect, though it is of all others the one in which blunders are most easily committed. The art is eminently useful, and is capable of almost unlimited improvement*; but it requires so much attention and expence, that it can never be kept up with spirit, without liberal encouragement, and good prices.

III. *On the proper Management of Stock in general.*

This is a subject which can only, in this place, be slightly touched upon†. It is an object of very great consequence to every husbandman, to expend, in the most economical and advantageous manner, the vegetable produce allotted for the maintenance of his stock, and to bestow it chiefly on those, from whom he is likely to derive the greatest, and the earliest benefit. Notwithstanding many recent, and truly valuable improvements, there still prevails, in regard to some particulars, a sad mixture of profusion on the one hand, and penuriousness on the other. The saving to the public, by careful attention to the feeding of live stock, would at all times be great, but in times of scarcity, would be incalculable. For the attainment of that object, it would be necessary to pay regard to; 1. The due preparation, and

* This is the opinion of Messrs. Bailey and Culley, the intelligent authors of the Northumberland Report. See p. 166.

† It is well observed in the Northumberland Report, (8vo. edition, p. 160), improvements in stock are not so easily spread as those of cultivation. If a farmer sees any modes of practice more beneficial than those he knew before, he can readily adopt them; or, if he discovers and selects a new variety of any species of grain, more productive and more valuable than any hitherto known, it multiplies so fast, that it is readily disseminated; but improved breeds of stock are not so readily diffused; they are much slower in their propagation, and much more easily contaminated, and are only to be preserved by attention and judgment.

frugal expenditure of their food; 2. The appropriation of that food to the different sorts respectively, according to the different species and breeds of stock,—their different habits and degrees of hardiness,—and the different degrees of exercise, and modes of treatment to which they are subjected; and, 3. The requisite attention to the demands of different periods, the relative effects of different seasons; and the state of the animals themselves, in regard to age, fatness, &c.*

The following general rules, as to the feeding and management of stock, may deserve attention.

1. Animals intended for the butcher, should be kept in a state of regular improvement. The finer breeds are highly fed from their birth, and are almost always fat. With other breeds, and on pastures of inferior quality, this is neither necessary nor practicable. But in every case, the same principle of improvement should be adhered to, and such animals ought never to be allowed to lose flesh, in the hopes of afterwards restoring it by better feeding.

2. The size should never be above that which the pastures can support in a thriving condition; nor can any thing be more injudicious, than to endeavour to increase the size of stock by crossing, without improving their pasture. The stock of every kind, and of all the various breeds, should, in respect of size, be proportioned to the quantity and the quality of their intended food†.

3. The best pasture should be allotted to that portion of the stock which goes first to market; the next in quality, to the breeders; and the less valuable pasture, to the inferior or growing stock. This division is highly advantageous. One hundred acres under this plan, would feed more than 120 promiscuously pastured.

4. Great care should be taken, not to overstock pasture, a practice which is attended with great loss to the farmer, and the community. This ought to be particularly avoided in regard to young and growing animals. If they are kept poor during one part of the year, they will scarcely thrive during the remainder; and when ill fed, will never attain their proper size and proportion; at the same time young stock, (their powers of digestion being stronger), may be fed on coarser and more succulent food, than those who are more advanced, and of age capable of being fattened.

* Coventry's Discourses, p. 144. † Middlesex Report, p. 228.

5. The kind of food given to animals, should be suited to their ages. In the habit of very young animals, there abounds, and seems necessary for their welfare, a great proportion of fluid; and therefore more succulent food may be preferable for them; but when they are more advanced and vigorous, the digestive powers being stronger, and time being requisite for the process of growth, provision less immediately nutritious, or of a coarser quality, may suffice. A dry kind of food would appear to agree better with all animals *in winter*, when the perspiration is less, than in summer, during which season, moister provision would seem to be more suitable*. When fed on dry food, and more especially if the quality is coarse, the stock should be well supplied with water, to promote its digestion in the stomach. It is indeed a good plan, previously to moisten any hay given to cattle, and in a less degree even to horses.

6. In regard to the diseases of stock, it may in general be observed, that the great object of the farmer ought to be, to ward them off, by obviating their remote causes; for most of those which affect our domestic animals, when once induced, are not easily cured, partly from their obscure nature, and partly from the difficulty of exhibiting remedies to the large numbers which are frequently seized at the same period, or in the same situation. In particular districts, many herds and flocks are considerably thinned, almost every year, by inflammatory and other disorders, which a little care and good treatment, applied in time, might easily have prevented†.

Lastly, the food, whatever it consists of, should not be too suddenly changed. It is seldom profitable, to bring lean animals immediately from coarse, to rich pastures; and a change from dry to succulent food, and *vice versa*, should be gradually effected‡. A change of pasture, however, of the same quality, tends to produce a greater accumulation of fat§.

It may be proper to add, that nature seems to have designed different sorts of animals for different purposes. A

* Coventry's Discourses, p. 166 and 168.

† Coventry's Discourses, p. 145. Breeding the lambs liable to have that inflammatory disease, called the *baxy* in Scotland, and giving them opening medicines, or green food, would, in a great measure, prevent the ravages of that disorder.

‡ General Report of Scotland, vol. iii. p. 22.

§ Paper by T. A. Knight, Esq. Communications to the Board of Agriculture, vol. ii. note, p. 186.

breed of cattle, equally well adapted to the butcher, to the dairy, and to the plough or cart*, is no where to be met with; and, so far as experience enables us to judge, these properties are hardly consistent with each other, and belong to animals of different forms and proportions. A large Herefordshire ox, for instance, would starve on a Highland pasture, and heavy Leicestershire sheep, were never intended to travel great distances, or to search for their subsistence in a rugged or mountainous country. The judicious breeder, therefore, will fix upon one object to be principally attended to; and he will endeavour to rear the species of stock, best suited to attain the object he has in view, or, in other words, the most likely to pay the most money, for the food he gives them. That can only be obtained, by an attention to the principles of breeding in general,—to the system best calculated for his own situation in particular;—and to the practice of the most eminent farmers who have excelled in the art†.

In regard to live stock, in general, it may be observed, that we ought to have in view, the keeping up of such a diversity of kind, of size, and of habit, as seem best adapted to answer our principal demands, and are the most likely to agree with the situation,—climate,—produce,—and other general circumstances of the country‡.

Sect. VII.—*Implements of Husbandry.*

The superiority of British husbandmen, over that of other nations, may, in a great measure, be attributed, to the numerous valuable implements employed in executing the various processes of agriculture. Both the abundance of capital, and the ingenuity of our mechanics, have produced that important advantage. The number of these implements, however, is so great, that the prudent farmer, in

* Perhaps the Herefordshire cattle approach the nearest to that perfect state, of any of the larger breeds. They arrive soon to maturity, and are fit for labour; but it is a different variety of the same breed, that is preferred for the dairy.—*Paper by T. A. Knight, Esq.* Communications to the Board of Agriculture, vol. ii.—Mr. Coke, of Holkham, has chosen the North Devons in preference; and with the care he has bestowed on the breed, he has already arrived at considerable success.

† Husbandry of Scotland, vol. ii. Appendix, p. 112. General Report of Scotland, vol. iii. p. 7.

‡ Coventry's Discourses, p. 149 and 135.

regard to that, as well as in every other branch of his art, must study economy. He should not incur an unnecessary expence in buying them, nor in purchasing more, than are essentially requisite, and can be profitably used. This maxim ought to be more especially attended to by young improvers, who are often tempted, under the specious idea of diminishing labour, and saving expence, to buy a superfluous quantity of implements, which they afterwards find are of little use*.

In purchasing implements, the following rules are to be observed: 1. They should be simple in their construction, both that their uses may be more easily understood, and that any common workman may be able to repair them, when they get out of order. 2. The materials should be of a durable nature, that the labour may be less liable to interruption from their accidental failure. 3. Their form should be firm and compact, that they may not be injured by jolts and shaking; and that they may be more safely worked by country labourers, who are but little accustomed to the use of delicate tools. 4. In the larger machines, symmetry, and lightness of shape, ought to be particularly attended to: for a heavy carriage, like a great horse, is worn out by its own weight, nearly as much as by what it carries†. 5. The wood should be cut up and placed in a position, the best calculated to resist pressure; and mortises, so likely to weaken the wood, should, as much as possible, be avoided: at the same time, implements should be made as light as is consistent with the strength that is necessary. 6. Their price should be such, that farmers in moderate circumstances can afford to buy them; yet for the sake of a low price, the judicious farmer, will not purchase articles, either of a flimsy fabric, or a faulty form; and, 7. Implements ought to be suited to the nature of the country, whether hilly or level, and more especially to the quality of the soil: for those which are calculated for light land, will not answer equally well in soils that are heavy and adhesive.

The subject of implements may be considered under the

* Coventry's Discourses, p. 47. It is remarked by an intelligent author on matters of husbandry, that a great diversity of implements, as they are more rarely used, prove in general a source of vexation and disappointment, rather than of satisfaction to the farmer. The operations of husbandry, cannot be performed by them properly, unless the person who is to use such implements, hath obtained that facility in the use of them, which continued practice can alone insure.—*Anderson's Recreations*, vol. iv. p. 47.

† Kent's Report of Norfolk, p. 121.

following general heads: 1. Implements of tillage, 2. For drilling or sowing corn; 3. For reaping corn; 4. For harvesting corn; 5. For threshing and cleaning corn; 6. For mowing and harvesting hay; 7. Of conveyance; 8. For draining; 9. For harnessing stock; 10. For rolling land; 11. For the dairy; and, 12. For various miscellaneous purposes. The intelligent farmer will be enabled to judge, from the description thus laid before him, what implements are the most essential, and the best suited for the purposes he requires.

1. *Implements of Tillage.*

These consist of ploughs, harrows, horse-hoes, scufflers, and a more recent invention, known under various names, scarifier, grubber, &c.

1. *The Plough.*—It is proper to begin with the plough, being the chief of all the implements employed in the extensive art of agriculture. There are several instruments used in husbandry, which, perhaps, might be dispensed with; but land cannot be cultivated to any considerable extent, or to much advantage, without the plough: for it is by means of that implement, that the strength of domesticated animals can be most usefully employed in the cultivation of the soil. In the formation of ploughs there is a great difference; and indeed they vary in almost every county, according to the nature of the soil, and other circumstances. But the great distinction necessary to be adverted to in this place, is, between the swing, and the wheel plough.

1. *The Swing Plough.*—The advantages of the swing, compared to the wheel plough, are, that its original cost is less;—that it is more easily kept in repair;—that, when properly made, it requires less strength to draw it;—that it is not easily put out of order;—that it is peculiarly well calculated for light soils;—and that when the land is at all wet, it is not liable to be clogged*.

As a decided proof in favour of swing ploughs, it is stated, that a farmer, accustomed to wheel ploughs on the light soils of Norfolk, proposed using them on a farm of

* Essex Report, vol. i. p. 128. It is disputed, whether the swing or the wheel plough, is least liable to friction. The additional action of the wheels, must certainly occasion more friction; but on the other hand, it is contended, that as a plough must have a tendency to go a certain depth, the pressure is relieved, and the draught is lightened, by having wheels in front.

strong loam in Suffolk, to which he had removed; but upon trying swing and wheel ploughs against each other, he was soon convinced, that the latter fatigued the horses more than the former; and that with wheel ploughs, he could not support his horses in such good condition, as with swing ones. He is now satisfied, that this would likewise be the case, even in light land*.

These observations, however, apply to swing ploughs made on a light, and ingenious construction, and not to those used in Middlesex, and other districts, which are of so clumsy and heavy a form, as to require the draught of one, or even two additional horses†.

It is at the same time to be remembered, in regard to swing ploughs, that they require experienced labourers. But where these can be had, a swing plough, with a pair of horses abreast, is a most efficient implement. Whether it will work any land, at all seasons, is a subject of much dispute. It is contended on the one hand, that a union of drying winds, with much heat, continued for a few weeks in summer, renders any clay land, hard and difficult to plough; and in such cases, if the clay should happen to be mixed with gravel, flints, or pebble stones, they become so firmly fixed, as to bid defiance to the efforts of swing ploughs.—On the other hand, it is observed, that if all these circumstances were admitted, it does not follow, that wheel ploughs are necessary to working the land, when it has got even into the hard state above described. That swing ploughs will answer *in the proper season*, even though the ordinary strength is only employed, is unquestionable; and when the proper season has been neglected, all that is required is, to increase the strength of the impelling power, by means of which every difficulty may be surmounted‡.

2. *Wheel Ploughs.*—The advantages of wheel ploughs are, that they require less skill in the ploughman;—that they keep a more regular depth§, and will turn a shallower furrow;—that they afford assistance to the ploughmen in soils of a stubborn, adhesive, or stony quality;—and, that

* Middlesex Report, p. 89.

† Middlesex Report, p. 86.—An engraving of the improved swing plough, and an explanation of the principles on which it ought to be constructed, will be found in the Appendix.

‡ Hertfordshire Report, p. 36; Surrey Report, p. 128, 129.

§ This is certainly an advantage, in ploughing up clover lays, or lands where sheep have been fed on turnips, where a furrow-slice, *of a regular depth*, is particularly desirable.

they are better calculated for trench ploughing. But, on the other hand, they are more expensive, both to purchase and repair;—they are more liable to be put out of order;—they require more strength to work them;—they are more easily disturbed by inequalities on the surface;—they encourage the workmen to rest a part of their weight on the handles of the plough, by which the draught and friction are so much increased, that both the horses and the plough wear out much sooner*;—and neither good mechanics, nor able ploughmen, can ever become numerous, while their ignorance, or their unskilfulness, can be so easily remedied, as by adding wheels to the plough†. Hence, in various places where experienced ploughmen could be had, wheel ploughs have been given up, as expensive and cumbersome‡.

Wheels, however, are found to be useful, in cases where either the trench, or the double-furrow plough is employed.

1. By the *Trench Plough*, two or more slices are taken with the same instrument. The first cuts off the weeds and stubble, and deposits them at the bottom of the furrow; the second slice is turned over the former, and completely covers it. This process suits only rather deep soils; and in them, many farmers consider it to be an advantageous mode of culture. The ploughs by which this process is effected, ought always to be furnished with wheels, in order that the deepness of the slice or furrow, may be properly regulated§.

2. *Double-furrow Ploughs* are recommended from high authority, as saving the attendance of one person, and doing nearly double the work, in the same space of time, with little additional strength in the team‖. They seem to be well calculated for level land, free from stones; or where the soil has been previously well reduced by other ploughs, but they are evidently less fit for general use, than single ploughs. They may answer for giving the seed furrow to barley land, where the soil is sandy, and has a flat surface¶;

* Middlesex Report, p. 89. To oblige the ploughman to walk upright, and to carry his own weight, the Norfolk and Suffolk ploughs, have but one handle, which soon tires the hand of the man who presses upon it. Ditto.

† Surrey Report, p. 123.

‡ Wilts Report, p. 68.

§ Middlesex Report, p. 92.

‖ Lord Somerville's Paper, in the Communications to the Board of Agriculture, vol. ii. p. 418. In the Papers of the Bath Society, vol. x. p. 82, there is an account by the late John Billingsley, Esq. of 385 acres being ploughed in eleven months by a team of six oxen, a ploughman, and driver, by a double-furrowed plough. They also harrowed at the same time 291 acres.

¶ Surrey Report, p. 123.

but they will not work where the land is formed into narrow and elevated ridges.

The *Paring Ploughs*, which have been long used in the fens, instead of a coulter, have what is called a *skeath*, or circular plate of iron, turning constantly round, the edge of which, and also of the share, are steeled, and kept sharp by a file, for cutting the turf*.

Swing Ploughs, on the whole, are greatly preferable for general purposes. The Rotherham, or Yorkshire plough, (with rather *a straight mould-board)*, was the first light swing plough for two horses, that was used in this country. It was thence introduced into Suffolk, and other English counties; and into Scotland, about the year 1742†. But it was not sooner than the year 1764, that a plough, with a *curved mould-board*, improved from the old Scotch plough, by Small, a native of Berwickshire, came into general use in that country. Some alterations on it have been suggested by James Veitch, an ingenious mechanic, near Jedburgh‡. The swing plough, constructed by the celebrated Arbuthnot in Surrey, has been recommended by the most respectable authority§; and now, in almost every part of the kingdom, and in Ireland, swing ploughs, of an improved form, can be procured‖.

2. *Harrows.*—Implements of this description are necessary in the practice of husbandry, to pulverize the ground,

* Huntingdonshire Report, p. 32. In some cases, instead of the *skeath*, they make use of a *slice*, as it is called, a sort of knife, difficult to describe, but calculated to effect the paring of a very tough dry surface.

† Subjoined to the Select Transactions of the Society of Improvers in Scotland, printed in January 1743, is this advertisement:—"The Rother-"ham plough, the drill plough, and the horse-hoeing plough, are better "made by Mr. Dalziel, at Newliston, near Lord Stair's house in West Lo-"thian, than by any other in this kingdom." This proves the period of the introduction of these implements into Scotland.

‡ In the Transactions of the Highland Society of Scotland, vol. iv. p. 243, there is a favourable report of Veitch's improved plough, with an engraving of it. It is longer than Small's plough, and more likely, on that account, to be adopted in England, where length is preferred.

§ Young's Lecture regarding Three Celebrated Farmers, p. 20

‖ An improvement in the plough-ear, or mould-board, of swing ploughs, has been recommended by the celebrated Jefferson, formerly President of the United States of America, who has cultivated the mechanical branches of agriculture with much success. A particular description of it is to be found in Brown's Treatise on Rural Affairs, vol. i. p. 260. The plan was tried, at the desire of the Board of Agriculture, by C. C. Western, Esq. M.P. of Felix Hall, in Essex; when it appeared, that it was constructed on a new and very ingenious principle. It was found, however, liable to this objection, that from the concavity, or flatness in the fore part of the breast, the loose earth of the furrow was apt to rest upon it.—*Essex Report*, vol. i. p. 138.

—to clear it of weeds,—to prepare it for the operation of sowing,—and to cover the seed when sown. It is evident, that the construction of harrows ought to depend on the nature of the soil. Those which are best calculated for strong clay, cannot be the most suitable for light sandy soils. The following are the principal rules regarding the formation of harrows: 1. That not any two of the teeth, should move in one track; 2. That the tracks should be at equal distances from each other; and, 3. That the teeth should either be round, or perhaps with a sharp edge bent forward, like so many coulters, as they make themselves cleaner than when they are square, or of any other shape, and work easier after the horses. The teeth of harrows are frequently made of unequal lengths, the front row being about half an inch longer than the second, and the third row being about one inch shorter than the first; so that each row backwards, is about one-half inch shorter than the one that precedes it. Where crops are drilled, an instrument called "the drill harrow," is found a very great improvement. It thoroughly cuts the weeds in the intervals, and harrows them up to the top in a very complete manner.

3. *Horse-Hoes.*—These useful implements are calculated, not only for destroying weeds, but also for pulverizing the soil, between the rows of plants set in straight lines, such as turnips, potatoes, or any sorts of grain, that have been sown in drills, at regular distances from each other. By these simple and effectual instruments, a great deal of manual labour is saved. At the same time, the hand-hoe is necessary for cutting up weeds, and loosening the earth between the plants, which the horse-hoe cannot reach.

4. *The Scuffler.*—This implement is derived from the Kentish nidget. It was originally, a small triangular and heavy harrow, the tines longer, and inclined forwards;—sharp and penetrating, but having *no plates* at bottom. Afterwards, however, a number of triangular plates, or feet, the edges of which are steeled, and fixed at the bottom of as many iron bars, somewhat similar to the legs and feet of a duck*, were added to it. It is a useful implement on light lands, that are free from stones, and of a plain surface, because it not only cuts up all weeds, but pulverizes the soil. Scuffling strong land, and exposing it to the sun and air, is greatly preferable to harrowing, which tends to consolidate

* Middlesex Report, p. 96.

the surface*; but it is necessary to have the land well reduced before the implement is employed.

5. *The Scarifier*, or *Grubber*.—This is an improvement on the scuffler, by having the iron bars bent forward for the purpose of penetrating the soil, and raising the root-weeds†. It is such an efficient implement, that no extensive farmer should be without it. If the ground has been previously completely loosened by the plough, it tears up the couch and other root-weeds, and brings them to the surface; acting at the same time both as a sort of plough and harrow. The coulters are put either in a square, or in a triangular wooden frame, with a small wheel, made of cast-iron, placed at each angle of the frame, which roll on the land, and regulate the depth to which the shares are intended to penetrate the ground. Such is the utility of this implement, in saving ploughing, and keeping the land clear of weeds, that it is supposed to have added considerably to the value of every farm where it has been introduced. Indeed, not only is labour thereby diminished, but the scarifier may be used to advantage in the following cases: 1. Barley and turnip land, after being once ploughed, may be made both clean and fine, by its means, and the harrowings and subsequent ploughings are thereby rendered unnecessary‡. 2. Where lands have been ploughed in autumn, the objection to the sowing of spring crops on the winter furrow, may be obviated, by the use of the scarifier§, as not only barley, but oats, (if not grown after grass), also beans, pease, and tares, may be sown without an additional ploughing. 3. Summer fallows may likewise be advantageously carried on with fewer ploughings, earlier in the season, and at less expence‖. 4. It may be effectually employed, to forward operations in the preparation of land, for potatoes or turnips, and after-

* Derbyshire Report, vol. i. p. 48.

† The edges should not be sharp, as they would cut the root-weeds, and render it more difficult to collect them.

‡ Middlesex Report, p. 66.

§ There is a particular account of the introduction of the grubber or scarifier into Scotland, in the Transactions of the Highland Society, vol. iv. p. 549. Mr. Fellenberg, the celebrated Swiss agriculturist, has sent to the Board of Agriculture, the model of a scarifier, with the coulters extremely bent, and without wheels, consequently the machine would be much cheaper, if, upon trial, if were found equally effectual.

‖ See Communication from Mr. Robert Hope, of Fenton, in East Lothian. —Appendix, No. V. He there observes, that the plough is necessary in fallows, to eradicate thistles, from the fast hold they take of the ground; but the grubber will extirpate every other root-weed. In soils where it is likely to be choked, the number of coulters should be diminished.

wards for raising the potatoe crop; and, 5. Its utility in mixing lime or compost with the soil, is of the highest importance; not only doing it more effectually than by the plough, but never placing these manures beyond their proper depth. Hence the scarifier or grubber, is considered to be one of the greatest improvements in the culture of the soil, that modern times can boast of*.

2. *Implements for Sowing Corn.*

Corn is sown, 1. By the hand; 2. By drill machines; or, 3. Dibbled.

1. *Hand-sowing.*—Though there are machines for sowing grain, and small seeds, not in regular rows, yet the most general mode, where drilling is not practised, is by the hand. In hand-sowing, it is necessary to have the assistance either of a hopper or of a linen-sheet. A hopper or basket, is a useful implement for the purpose, as with it, the man has considerable freedom in stepping, which is of as much importance as the management of the hand†. The sower likewise can fill a hopper himself, without the aid of another person‡. In several districts they use a hopper made either of chip or straw, bent, to favour the side of the man who sows the grain, and swung by a strap over the shoulder; but on the whole, the sower walks rather more at his ease, with the corn in a sheet, than when it is carried in a basket§.

2. *Drill-machines.*—It is certainly desirable, that every species of seed, should be sown in a regular manner, and at a proper depth, and a variety of useful machines have been invented for that purpose. They have been objected to, on account of their being complicated and expensive; but in these respects, improvements have been already made, and there is reason to hope, that they may still be brought to greater simplicity and cheapness.

To facilitate the operation of drilling grain, much ingenuity has been displayed. The drills of the Rev. Mr. Cooke, and of Mr. Bailey of Chillingham||, have been deservedly celebrated. A new machine, invented by Mr. Frost, late

* Suffolk Report, p. 36. † Warwickshire Report, p. 60.

‡ Surrey Report, p. 140.

§ Durham Report, p. 85. The Hertfordshire practice of sowing under furrow, is described in the County Report.

|| In Mr. Brown of Markle's valuable work, "Treatise on Rural Affairs," vol. i. p. 296, &c. there is a good account of Mr. Bailey's drill-machine.

of Saham, has been exhibited at Holkham, and has met with much approbation. It is found equally applicable to strong and wet soils, or where ridges render the surface uneven, as on light, dry, and flat lands. The different shape of the coulters, in the respective drills, is also worthy of notice. In the common drill, the groove in the soil is made by pressure, leaving the bottom narrow and glazed, which, if a drought comes on, frequently becomes hard; whereas, in Mr. Frost's machine, the groove is made, *by cutting it out*, leaving the bottom and sides in a state perfectly loose and friable. Hence this machine is peculiarly calculated for the strong land farmer. In common drills, the seed deposited, often varies in quantity, in going up or down hill; and though, by very great attention in the person who works them, it may be somewhat regulated, it is effected, in Mr. Frost's machines, completely and accurately, without any extra attention in the drill-men, the hoppers swinging on a centre, are always perpendicular, and receive the seed equally, on level, or unlevel ground, whether in going up or in going down hill*. These improvements greatly remove the objections which have been made to the general adoption of the drill system.

The simple drill machine for sowing turnip-seed, cannot be too much recommended. It has been the means of rapidly extending the culture of that valuable plant. Various useful machines for drilling pease and beans have likewise been constructed; and an implement has also been invented, not only competent to the task of sowing grain, or turnip-seed; but at the same time, it gives out the pulverized manure to be used with them.

Connected with the drilling system, are the various implements used for hoeing; in particular, a machine invented by the ingenious Mr. Blaikie, called "The inverted horse-hoe," which tends greatly to improve the system of sowing turnips on ridges; the soil being thrown inwards, instead of incumbering the young plant. The principle is adapted at pleasure, to single, double, or treble rows of turnips; and to wheat, drilled, at nine inches interval; as well as to pease, and turnips at eighteen, or twenty-seven inches†.

Among other machines calculated for the row-culture, the drill-barrow ought not to be omitted, being peculiarly adapted for small farms. It is very simple, and may be used in two ways:—1. Either a box or barrow is attached

* Dr. Rigby's Report on the Husbandry of Holkham, p. 36, 37, and 38.
† Ditto, p. 53.

to the plough, by which the seed is deposited in the furrow as the plough goes along, and it is covered by the next furrow slice; or, 2. A boy, with a barrow, follows the plough, depositing the seed in the bottom of the furrow.

3. *Dibbling.*—This practice has many admirers, and was for some years much used in Norfolk, for wheat, till the price of labour rendered it too expensive. On the whole, it is rather on the decline, being found minute and troublesome. The tools used are simple, being merely an iron dibble, about three feet long, with the point of which, holes are made for the reception of the seed. The dibbler walking backward, holds one in each hand, with which two holes are made at the same instant, about four inches from each other, and one or two inches deep; while women, or children follow, and drop in the seed*. In light soils, this plan seems to be well calculated for clover leys, the pulverization of which is unfavourable to the culture of wheat; whereas, by these instruments, the seed may be dibbled into the very centre of the *flag*, or furrow-slice, (two rows in each), and the plant has thus a better hold of the ground. But whenever the soil has any mixture of clay, the dibbling of wheat has an injurious effect on the soil, which stints the growth of the plants†. In Gloucestershire, they dibble beans and pease, and many consider it a better plan than drilling them, unless in loamy soils‡. The bean drill, however, on strong clays, answer the purpose effectually, and with more expedition.

3. *Implements for Reaping Corn.*

Crops are cut down, by British farmers, either by the sickle, the reaping-hook, or by the scythe.

The sickle is light and narrow, and has teeth; the hook is heavy and broad, and has a smooth edge. Respecting the superiority between these tools, there was formerly a difference of opinion; but it is now generally admitted, that, for the operations of what is technically called *reaping*,

* More complicated machines have been invented, as "*the self-sowing dibble*, &c.; but the simple one is generally preferred.

† In this case, the dibble has an injurious effect, by placing the seed in a hollow pot, which collects and retains moisture; and encircling it in a socket of so tenacious a material as clay, through which water cannot percolate, or by any means be discharged, it stints the growth of the plant, and often causes the seed to decay before it vegetates.—*Remark by the Rev. Robert Hoblyn.*

‡ Gloucestershire Report, p. 125 and 129.

those with teeth are preferable to the smooth ones, owing to the time required in sharpening the latter; for those with teeth, may be employed for several weeks without being sharpened, and the smooth ones require this several times in an hour. Where the art of bagging is introduced*, the hook without teeth is indispensable. But in the fen countries, they reap oats, and sometimes barley, by the hook, the straw being long, and the crop often much inclined, the work could not be commodiously executed with sickles.

The expence of cutting down by the scythe, is less than by the sickle; and, in a wet season, corn cut down by the scythe is more easily harvested, or is less apt to heat in the stack-yard. The celebrated Culley preferred the scythe for barley. It is, however, objected to that instrument, that it does not lay the ears of the corn so regularly, as is done by the reaping-hook. This is a great disadvantage where the threshing-mill is employed, as the corn should be put into the mill as straight and regular as possible.

A method of reaping, new to us, has lately been introduced from Flanders. It is executed in the following manner: The reaper carries in his left hand, a stick with an iron hook, with which he collects as much grain as he can cut at one sweep, with a short scythe which he holds in his right hand. By practice, they are able to carry on this double process, with great spirit and dexterity†. Cradle scythes have also been tried, but they do not work well, where corn is long, or inclined, or foul, or where it is grown in rows.

Various attempts have been recently made to construct reaping machines. If they could be supplied at any reasonable expence, their advantages would be very great; for though they can hardly succeed in rough or uneven fields, yet, on level ground, they may be brought to answer. The general price of reaping with the sickle or the hook, is about twelve shillings per English acre. But with a well-constructed machine, if such could be invented, the expence would necessarily be considerably reduced‡.

* Vide Chap. IV. Sect. 1. No. 8.

† George Rose, jun. Esq. has great merit, for his exertions to establish the use of this implement in Hampshire.

‡ A machine for that purpose, has been invented by Mr. Smith, near Dumblane, in Scotland, which displays much ingenuity.

4. *Implements for Harvesting Corn.*

It is now generally admitted, that the best mode of harvesting crops of grain, is by carts. They are more easily loaded and unloaded, and managed with less difficulty than waggons.

For the preservation of corn, stacks are greatly preferable to barns, more especially since the plan has been adopted, of placing them on stone or cast-iron pillars*, by which the corn, being clear from the ground, is kept perfectly dry, and the access of mice or other vermin prevented. The advantages resulting from these practices, may be estimated at above one-thirtieth part of the crop†.

In some districts, if the season be wet, stacks have *bosses* placed in the centre, consisting of a triangle of wood, through which the air has freedom to circulate, nearly to the top of the stack; and which is of great service in preventing the grain from spoiling, if it be not perfectly dry when harvested.—(*See the Engravings*, Plate III.)

5. *Implements for Threshing and Cleaning Corn.*

There are three sorts of machines calculated for these purposes: 1. The threshing-machine;—2. A machine for dressing barley;—and, 3. Fanners, or winnowing-machines.

1. The threshing-machine is considered to be the most valuable implement that modern times have produced. The saving of manual labour, and that of a severe kind, by means of this invention, is perhaps beyond calculation, while the grain is separated from the straw, in a more perfect and expeditious manner, than has hitherto been accomplished by any other mode. Nothing could be more barbarous, than the modes adopted by some of the ancients, of separating the grain, either by burning the straw, or by treading the corn with the feet of horses or oxen; nor could any species of labour be more fatiguing, than threshing, by so defective an instrument as the flail. Thence many attempts had been made, at various times, for constructing machines, competent to the task of threshing in a

* A great improvement has been made in the form of these cast-iron pillars. They ought to be cast in *two* pieces, the head separate from the rest. It is thus of a cheaper construction, and if the head is bent inwards, the access of vermin up the pillar, becomes impracticable.

† Particular care should be taken, not to leave ladders, or other articles leaning against the stacks, for the vermin will climb up them.

superior style. Is is to the ingenuity of a Scotch mechanic, (Andrew Meikle), that we are indebted for the perfection, if not the sole invention of a machine adequate to that purpose. To him, at any rate, must be attributed, the merit of suggesting the drum, with fixed beaters, by which the corn and straw are separated in the most satisfactory manner. In other attempts to construct this implement, the plan of the flax-mill had been adopted*.

Threshing-mills are driven by various powers, as by horses;—oxen†;—wind alone;—wind, or cattle when the wind fails;—water alone, or by cattle when the water is deficient;—and steam. Portable machines are not uncommon in various parts of England; and with them, from 16 to 24 quarters of wheat, or 33 quarters of rye, have been threshed in a day. Some machines are driven by manual labour, and they may be adequate to thresh the crops grown on small farms, by introducing only the head of the grain into the machine‡; but even in that case, a moderate sized horse, or ox, or water, or wind, would be a better power to apply. On the whole, it is most advisable, to have the mills of a substantial construction. The saving a little money, and getting a bad machine, is wretched economy. A six-horse power is little enough for all the necessary operations, on a farm where wheat is cultivated; though, by shortening the drum, fewer horses may be used.

The specific advantages resulting from this invention, may be thus briefly stated: 1. From the superiority of this mode, one-twentieth part more corn is gained from the same quantity of straw, than by the old fashioned method. 2. The work is done much more expeditiously. 3. Pilfering is avoided. 4. The grain is less subject to injury. 5. Seed corn can be procured without difficulty from the new crops, for those to be sown. 6. The market may be supplied with grain more quickly in times of scarcity§. 7. The straw, softened by the mill, is more useful for feeding cattle. 8. If a stack of corn be heated, it may be threshed in a day, and

* Husbandry of Scotland, vol. i. p. 79. Every friend to merit must rejoice to hear, that the inventor of so important a machine, was rendered comfortable in his old age, and enabled to provide for his family after his death, by the voluntary donations of his grateful countrymen.

† The advantage of using oxen, as the best animal power, can hardly be doubted, provided the machines are very highly calculated.

‡ This plan is the most likely to be adopted in foreign countries.

§ See an instance of this in the Kent Report, p. 59, where the bakers of Deal and Dover, were thus immediately supplied with flour, which otherwise might not have been practicable.

the grain, if kiln-dried, will be preserved, and rendered fit for use. 9. The threshing-mill lessens the injury from smutty grain, the balls of smut, not being broken, as when beaten by the flail; and, 10. By the same machine, the grain may be separated from the chaff and small seeds, as well as from the straw. Before the invention of threshing-mills, farm-servants and labourers endured much drudgery; the large corn farmer, sustained much damage from bad threshing; and had much trouble, vexation, and loss, from careless and wicked servants; but now, since the introduction of this valuable machine, all his difficulties, in these respects, are obviated.

Mr. Brown of Markle, in his Treatise on Rural Affairs, has presented the following estimate of the profit that might be derived by the public, were threshing-mills used in every case, in this country, for separating corn from the straw. He calculates,

1. The number of acres producing grain in Great Britain, at	8,000,000
2. The average produce in quarters, at 3 qrs. per acre, at	24,000,000
3. The increased quantity of grain produced by threshing-mills, instead of using the flail, at one-twentieth part of the produce, or in quarters, at	1,200,000
4. The value of that increased quantity at 40*s.* per quarter	2,400,000
5. The saving in the expence of labour, at 1*s.* per quarter	1,200,000
6. The total profit *per annum*, to be obtained, at	3,600,000
7. The actual profit *per annum*, on the supposition that only half of the grain produced, were threshed by machines,	1,800,000

It is not then to be wondered at, that he should pronounce the threshing-mill to be the most valuable implement in the farmer's possession; contending, that it adds more to the produce of the country, than any invention has hitherto done; and that it ought to be accounted, the greatest improvement that has been introduced into Great Britain, during the present age*.

2. A machine has been invented for dressing, or taking off the awns or spikes of barley, which is recommended as a great improvement by those who have used it. Sometimes it is attached to threshing-mills, and though there must be some additional stress to the power by which it is moved, it is but trifling†. In well-constructed threshing-mills, however, this operation is frequently done by the mill itself.

* The threshing-mill has been objected to, as diminishing the field for labour. But those who are thus deprived of work, might be much more advantageously employed in making the farm roads.

† Husbandry of Scotland, vol. ii. Appendix, No. 6.

3. Many imperfect modes were used, in former times, for separating the grain from the chaff, as by dropping it from a sieve or basket, between the two doors of a barn exposed to the wind;—by throwing or *casting* it with shovels;—and by the common method of the *fan* and *riddles*, to which was sometimes added *reeing*, or hand-dressing. In modern times, machines have been constructed, to blow, riddle, and skreen at one operation. By the use of these implements, the husbandman can clean his corn at any time when necessary*. Fanners, or dressing machines, have been greatly improved since their first introduction, and are now to be seen, not only in every corn-mill, but almost in every barn, where the farm is more employed in tillage than grazing. When annexed to threshing-mills, and properly fitted up internally, with suitable riddles, and harps, or skreens, corn is often rendered fit for the market, as it comes from the machine†.

6. *Implements for making Hay.*

The scythe, an essential implement in this operation, is so well known, that it does not require to be described‡.

Instead of the usual mode of *tedding* grass, or shaking it out of the swathe, and strewing it evenly over the ground, for the object of drying it expeditiously, a machine has been invented, of a circular form, with spikes, by which the largest crops are separated, thrown into the air, and scattered about in a very perfect manner. By this means, the manual labour of tedding natural grass is abridged, and the work is done better and more quickly. It is not, however, calculated for clover, which ought to be as little shaken as possible, its head and leaves being so apt to break off.

When the intention is, to stack the hay in the field in which it grew, and it has been formed into large windrows, it may then be put into what is called "*a sweep*," a machine made of wood, for holding the hay, by which it may be dragged along the field by four horses in pairs, to the

* This useful machine, it is said, originated in China, and, along with that for making pot-barley, was introduced into Scotland from Holland, about a century ago, by Mr. James Meikle, father of Mr. Andrew Meikle, inventor of the threshing-mill. Mr. Fletcher of Salton, sent him to Holland for that purpose. See Farmer's Magazine, vol. i. p. 158.

† General Report of Scotland, vol. i. p. 232.

‡ It may be proper to state, that they are variously made up, and are in some places very defectively put together, for mowing smoothly, and with care. In some parts of Bedfordshire, they excel in this particular.

place where it is to be stacked. This machine is so easily and expeditiously loaded and unloaded, that it may be of great use in securing the hay in precarious weather*.

7. *Implements of Conveyance.*

The inconvenient, tedious, and expensive modes of conveying agricultural productions, either on the backs of horses, on hurdles, or on sledges, are now rarely to be met with. The usual means of conveyance now are, by the cart, the Irish car, the tumbril, and the waggon.

1. Carts are beyond doubt the cheapest, and also the best kind of carriage for the farmer. They may be used in almost any situation. In a flat country, they are evidently preferable to any other; and though in a hilly district, some objections may be made to them, when going either up or down hill, yet on the whole, no other carriage can be dragged up so easily, and means have been invented by which their safe descent may be facilitated and insured. By means also, of a light frame, or what is called a *harvest top* (which may be occasionally fixed upon them), carts are rendered fit for carrying a considerable quantity of corn, hay, straw, or other bulky, but light articles.

It has been disputed, whether carts should have one, two, or even more horses.

The arguments in favour of single-horse carts shall be briefly stated, from the importance of the subject, and the difficulty of surmounting the prejudices against them, in those places, where larger machines have been in use.

In behalf of single-horse carts, it is contended: That they are cheaper, both in regard to the original purchase, and the repairs;—that greater loads are carried per horse†;—that they are more effective in harvest than the waggon‡;—that they are less liable to loss by accidents; for if one wheel of a waggon breaks down, the whole team is stopped;

* There is a particular description of this machine, invented by John Middleton, Esq. in the Transactions of the Society of Arts, vol. xiv. p. 190.

† See Annals of Agriculture, vol. xxix. p.148; where it is maintained, that from 20 to 35 cwt. may be conveyed by a single horse. But a ton, or even 16 cwt. is in general sufficient for a horse, even upon a good road, to go any distance,

‡ Indeed, Dr. Anderson maintains, that the same number of horses, with carts properly constructed, will do no more than double the work in harvest, that can be done by waggons; but were the difference only from two to three days in a week, that is of immense consequence in a precarious climate. Dr. Anderson's Recreations, vol. iv. p. 112. Waggons are sometimes detained two hours in a field before they are filled.

—that the division of draught is useful, for no skill in driving can make all the horses in a waggon draw exactly an equal share;—that they are loaded with greater ease and convenience, and are handy for almost every purpose;—that the size of the wheels may be adapted with the greatest nicety, to the height of the horses;—that the load may be so conveniently placed, as to lessen the draught;—that in proportion to the load, the cart has less weight of carriage;—that the power is nearer the weight drawn;—that they occupy less space when out of use, than waggons;—that it is much better for the horses to act singly than conjunctively, as a horse in the one case, has nothing but his load to contend with, whereas in the latter, he is generally embarrassed by some difference in point of rate of going, greater or lesser heighth, strength, temper, &c. with his companion in the machine*; and lastly,—that single-horse carts are greatly to be preferred for the preservation of roads†.

Others maintain, that single-horse carts can only be beneficially employed in dry weather, when the roads are good; and though in such roads, one man can manage two of these machines, yet, that in general, each single-horse cart must have a man to drive it, which is of itself an objection of great importance, more especially during the harvest, when hands are scarce.

In regard to double-horse carts, many farmers are partial to them, where much field labour is to be performed; and where the roads are so bad, that a single-horse cart can make but little progress. In drawing up steep banks, or going to a great distance for lime, &c. two horses may likewise be desirable; but such a load as two horses can draw, is so heavy, that in going over a farm, the wheels sink into the ground, to the great injury of the land, particularly when in grass.

The practice of putting three or four horses in a cart, (as is done in the neighbourhood of the metropolis), deserves reprehension. When such carts are empty, they are consi-

* Lord Robert Seymour's Paper, Annals of Agriculture, vol. xxvii. p. 337. It is there maintained, that two horses singly, will do as much as three conjunctively.

† Paper by Arthur Young, Esq. Annals of Agriculture, vol. xviii. p. 178. In Ireland, the Scotch dray and cart, are very generally in use, the former for conveying goods and merchandize, and the latter for agricultural purposes. From 20 to 25 cwt. is a very common load for one horse under a dray, which generally travels at the rate of 20 miles per day.—*Remark by Edward Burroughs, Esq.*

derably heavier than one horse can draw in constant work*; and seldom much more than a ton is conveyed by such carts, even with three or four horses†.

Where oxen are used, it is better that they should be yoked in pairs; and Lord Somerville, with his usual zeal for agricultural improvement, gave the description of a drag cart for two oxen, by which they would be able to draw a considerable weight, even in a hilly country‡.

2. Irish cars have their advantages. They are easily filled;—pass confined gateways with facility;—can be drawn upon soft meadow or ploughed grounds, with little injury or inconvenience;—and the wheels being cylindrical, they are much less destructive to roads. They were recommended, for these reasons, by Bakewell, and the late Mr. Wilkes of Measham§; but they do not carry such heavy weights, as single-horse carts will convey‖. The Irish car has, of late, been much improved, having got iron axle-trees on the same plan as carts¶.

3. Tumbrils with three wheels, are of use for particular purposes; as, for carrying dung, or conveying marle from a pit. In the latter case they are so efficient, that Mr. Kent calculates 30 per cent. might be saved by using them**.

4. Where the country is level, the roads free from ruts, and the people rich, (as the brewers, distillers, and some farmers of Surrey and Middlesex), they indulge in expensive horses, and teams of parade and show††; but in general, these teams are but little adapted for agricultural purposes, more especially for the corn or hay harvest, when expedition is so essential. Heavy waggons also, are greatly to be objected to in hilly districts, as the wheels must be frequently locked, by which the roads are ploughed up, and most essentially injured.

8. *Implements for Harnessing Stock.*

Harness, or the traces, trappings, yokings, and furniture of animals employed in draught, are articles of considerable expence, but of great utility. If the best mode of applying the power of different animals by proper ligaments, as well

* Middlesex Report, p. 94.

† Surrey Report, p. 159.—It is surprising that so prudent and intelligent a people as the English did not find this out long since.—*Remark by Edward Burroughs, Esq.*

‡ Communications to the Board of Agriculture, vol. ii. p. 415.

§ Ibid. vol. ii. p. 417. ‖ Derbyshire Report, vol. ii. p. 61.

¶ Remark by Edward Burroughs, Esq. ** Kent's Norfolk, p. 118.

†† Middlesex Report, p. 94.

as the materials of which they ought to be made, be taken into account, it will be evident, that the subject is of more importance, than farmers seem in general to be aware of. Economy, however, in this article, where it does not interfere with fitness, should be particularly adverted to*; above all, throwing away money in useless ornaments, ought to be avoided. Great care ought likewise to be paid to the preservation of the harness, as it consists of articles easily damaged, unless kept in the most perfect order.

9. *Implements for Draining Land.*

In the implements for this essential purpose, England certainly excels. Where the ground is soft, the drains may be cut with a spade; but where it is hard, or full of stones, the mattock or pick, must be made use of. The tools used for hollow-draining, according to the Essex system, are extremely ingenious and appropriate for that purpose. Various sorts of draining ploughs have been invented; which, being of a complicated construction, have seldom been used with advantage. The *mole plough*, as it is called, is likely to be of service in draining soils free from stones; and is found to be particularly useful in pasture land. These implements shall be more fully discussed, when the subject of draining is treated of†.

10. *Rollers.*

The roller is the most valuable implement, for breaking hard clods expeditiously, and smoothing the surface of the land when in tillage, ever yet invented. It is likewise of use to grass lands laid down for hay; and heavy rollers would prevent those ant-hills, by which so many pastures are deformed‡. Rollers are made of various substances; as, wood, freestone, granite, or cast-iron; but on the whole, the two latter are to be preferred. It is of importance, that the weight of the roller, should be in proportion to the extent of surface on which it rests, and the nature of the land on which it is to operate. The best plan is, that of having two rollers, each about two feet and a half in length, and both

* Anderson's Recreations, vol. iv. p. 14. † See Chap. III. Sect. 3.

‡ Buckinghamshire Report, p. 114. Mr. Coke of Holkham, has a cast-iron roller that cost 60*l.* It weighs three tons and a half. It is five feet six inches in diameter, as well as in length. It leaves the grass fields in the best possible order.—*Young's Norfolk*, p 50.

placed in one frame, so as to roll clear of one another. This is the most suitable both for corn crops and sown grass, as it neither tears up the tender soil, nor injures the young plants, and also acts better, when any inequalities are to be met with on the surface. Besides, the labour in turning is much less severe on the frame, and on the cattle. Every farm ought to be provided with rollers of different diameters and weights, so as to suit the several purposes to which they are destined; those of a small diameter are generally applied to land in tillage; and those of a large diameter, with double shafts, to grass land. Heavy rollers are of great use, for destroying worms, slugs, and other vermin in the soil*.

11. *Dairy Implements.*

The most essential implements for the dairy are: Milk-dishes; Churns; and Cheese-shapes and Presses.

1. A number of articles have been used for holding milk, as, wood, stone-ware, slate, and lead, but none of them can be compared to those made of cast-iron, lately invented. They are softened by annealing in charcoal, turned smooth inside, and then laid over with a coat of tin, to prevent the iron coming in contact with the milk, the rust of which might injure it. To prevent rust also, the outside of the dish is painted over. They are easily kept clean; and preserving a proper degree of coolness, the milk throws up more cream than in wooden dishes. Nor are they expensive; for a dish, to hold an English quart, only costs 1*s.* 2*d*†.

It is objected to earthen-ware dishes, that they are commonly glazed with the glass of lead, which the acid of milk very readily dissolves, and thus forms a compound of a most poisonous nature. But some consider this to be a refinement, as lead itself has been used for ages, (and still is in Cambridgeshire, Lincolnshire, &c.) without any perceptible ill effect; and milk seldom stands to be sour.

2. A variety of churns are in use. Of these, the sort shaped like a barrel, is much approved of, being simple, easily wrought, and capable of being made of greater or

* Essex Report, vol. i. p. 147.—The drill roller is an efficient instrument for breaking down the clods of rough fallows.—*Derbyshire Report*, vol. ii. p. 46.—The spike roller is well calculated for stony clays, and will bring them into a pulverized state, at a trifling expence. By the common roller, large lumps cannot be reduced, unless they are in a moist state; whereas the spike roller will accomplish that object, however large or hard they may be.—*Remark by Edward Burroughs, Esq.*

† Husbandry of Scotland, vol. i. p. 118.

lesser dimensions, according to the extent of the dairy. Others recommend a churn somewhat in the shape of a cradle, but on a frame of wood. It is rocked regularly, not faster than the pendulum of a clock; and answers the purpose of making butter uncommonly well*.

3. In the manufacture of cheese, the shape, (called a *vot*) and the press, are important articles. The best kind of shape is that made of cast-iron; and the kind of press most esteemed is, that which is made of granite. Large hewn stones, lifted by a screw, are advantageously used for pressing cheese†.

12. *Miscellaneous Articles.*

A variety of small implements for the barn, for the stables, and for the other offices, are necessary; but do not require any particular enumeration. There are four machines, however, of greater importance than the rest, and of them some account may be given: 1. The straw-cutter; 2. The turnip-slicer; 3. The bruising machine for beans, pease, or oats; and, 4. The weighing engine.

1. Machines for cutting straw or hay, are certainly of use in preventing waste, and preparing coarse food, as straw, for horses or cattle. These machines, till of late, were separate, and the work was executed by manual labour; but the purposes of the cutter are more effectually accomplished, when it is annexed to any machine, as a threshing-mill, driven by water, by wind, or by cattle.

2. Machines have also been invented for slicing turnips or potatoes, to be given to stock. In regard to the latter, however, steaming, boiling, or baking‡, seems to be preferable.—There is something injurious in the juices of the potatoe in a raw state, which cooking eradicates, or great

* There is an engraving of this implement in the Appendix, Plate IV. It was first heard of at the Board of Agriculture from Wales. Doctor Skene Keith, since states, that it has been used in Aberdeenshire for these forty years past. In Lambert's Travels through Lower Canada, and the United States of America, (printed in London an. 1810), vol. ii. p. 109, the following account is given of the American cradle churn: "At a farmer's near Lake Champlain, we saw a machine for churning butter. It was a kind of half barrel, with a place where one of the farmer's sons sat astride as on horseback. The machine moving up and down, answered the double purpose of a churn for making butter, and a rocking-horse for his children."

† Derbyshire Report, vol. ii. p. 56.

‡ In the Communications to the Board of Agriculture, vol. iv. p. 296, there is an account of Mr. Pierrepont's mode of baking potatoes, and an engraving of the oven. The plan answers so well, that even large oxen are fattened on them, when thus prepared.

heat dispels. How far the increased value of the steamed food, will compensate for the expence, has not yet been ascertained.

3. Bruising beans, pease, or oats, for the feeding of horses, is a practice much to be recommended; it having been found by experience, that by feeding horses with bruised grain, seven bushels, will go at least as far as eight of the same quality given whole*. This saving is at all times an object of importance, but more especially in times of scarcity.

4. A weighing machine is, certainly, to farmers, an expensive article; but where it can be afforded, it is of much consequence, more especially to those who fatten stock. Indeed without it, no farmer can ascertain the progressive weight of any particular animal which he feeds;—nor the value of the articles that he uses;—nor the return that stock make for their food. It is otherwise all guess-work; and many vague assertions have been circulated as truths, which have afterwards been found erroneous, when the experiments were made with accuracy†.

A variety of other machines are to be found in the possession of agricultural societies, who very properly patronise every new invention that promises to be useful; though few of them can be employed by the farmer, with real profit. Indeed, when these machines are complicated, though they may succeed in the hands of an ingenious artist, yet they can seldom be used with advantage, by the ordinary class of labourers.

There are four additional points which remain to be considered on the subject of implements: 1. The materials of which they ought to be made; 2. The means of repairing and preserving them; 3. The propriety of introducing new implements in a district; and, 4. The means of improving their construction.

1. Agricultural machines were formerly made almost entirely of wood; but now, in many instances, they are constructed either in whole, or in part, of hammered, or of cast iron. The rapid extension of the great improvements made in the plough, by Small, were chiefly owing to his getting a

* General Report of Scotland, vol. i. p. 248. The calculations of Edward Burroughs, Esq. go still farther. He is confident, after the experience of four years, that he has saved one-third of corn, in the quantity, which his horses would have otherwise consumed, had it been given them unbroken.

† Mr. Salmon, of Woburn, has invented a portable machine for weighing oxen, at from 25*l.* to 50*l.*—*Bedfordshire Report*, p. 215.

mould-board*, and other parts of his plough, cast in iron, from patterns in wood; and plough-makers being thus furnished, with an approved model, of the most difficult parts of the plough, were soon enabled to put the rest together, and to spread the same improved instrument all over Scotland†. The use of iron will probably, in many other instances, supersede that of wood. It is peculiarly well calculated for hot and dry climates, being inaccessible to the attacks of insects. It may, indeed, be observed, that though implements in constant use, may be made either totally, or partly of wood, those which are only occasionally employed, should, if possible, be made of iron, as, when the season is over, they are apt to be negligently laid by, and if made of wood, suffer much injury‡.

2. Every careful farmer, will lay it down as a rule, to have an inventory of all his implements, and other articles therewith connected; and frequently to inspect them, so that when any part of them is observed to be in the least damaged, or in danger of giving way, it may be immediately repaired. An implement, likewise, that is not longer wanted during the season, ought not only to be carefully laid up; but before it is put aside, it should be well cleaned, rendered perfectly dry, oiled, or, if made of iron, painted, and kept so as to be ready for use when wanted. No circumstance marks more the character of an attentive husbandman, than great attention to his farming implements. Upon every farm, also, there ought to be one or more places, properly constructed, for holding the larger implements; and some secure place allotted, for containing the smaller tools. Where machines are necessarily exposed in the field a great part of the season, they require to be new painted, at least every second year. This defends them, not only from drought, but also from rain and rust§.

3. The introduction of new implements into a district, is often a matter of great difficulty, owing to the ignorance, the prejudices, and the obstinacy of farm-servants and labourers. Many farmers, therefore, very absurdly retain

* Called also the plough-ear,—earth-board,—plat,—wrest, &c. &c.

† Husbandry of Scotland, vol. ii. Appendix, No. 5, p. 28. Some directions for cutting down, and preparing wood for agricultural machinery, extracted from Lord Kames's Gentleman Farmer, will be found in the General Report of Scotland, vol. i. p. 251.

‡ In laying by a plough, the share should always be knocked off, and the *head*, or bottom, cleaned from earth.

§ Coventry's Discourses, p. 49. General Report of Scotland, vol. i. p. 252.

their old implements, though convinced of their inferiority, rather than sour the temper of their labourers, by attempting to introduce new ones. In several cases, however, by attention, perseverance, and by rewarding those servants who have been induced to give the new machines a fair trial, they have succeeded in the attempt.

4. The importance of proper implements is such, that the melioration of those in use, would be an essential advantage to agriculture; and great as are the mechanical improvements which have been already made, many of them are capable of being brought to still greater perfection. Persons of genius and experience, therefore, ought to be encouraged, to devote their time and attention to this important object; and to exert themselves, either to improve the various sorts of implements now in use, on scientific principles, or in the invention of superior ones, as circumstances may require. The discovery of an useful implement, by which the labours of agriculture can be abridged, or brought to a still higher degree of perfection, and the expence of cultivation, at the same time, diminished, cannot be too much encouraged, as likely to prove of essential service, both to the farmer, and to the public. It is calculated indeed, that an immense advantage would accrue, from even *the general adoption* of the improved implements now in use in particular districts. Mr. Curwen is of opinion, that the farmers in the southern counties of England, lose at the rate of 25 per cent. by the heavy carts and waggons they employ*; and there can be no doubt, that the introduction of two-horse ploughs and threshing-machines, where these implements are unknown, would lessen the expence of labour, at least 10 per cent. more.

Sect. VIII.—*Farm Buildings, and Cottages connected therewith.*

The agricultural prosperity of a district, depends, in a considerable degree, on the condition of farm-houses, and offices, and of the cottages in which the labourers reside. This cannot be too much inculcated. The health and happiness of those employed in husbandry require, that they should have a comfortable habitation to retire to, when their

* Curwen's Report, p. 77.

labours are over. In arable farms also, it is of much advantage, to have a set of substantial and well-arranged offices, adequate to the size of the farm, and suitable to the system of husbandry adopted in it, without which, the servants cannot do their work properly;—the cattle cannot be expected to thrive;—nor can any operation in husbandry be carried on with the same success, as when such accommodations are provided*.

In discussing this subject, it is proposed briefly to consider;—the general principles on which agricultural buildings ought to be erected;—the proper position of a farm-house and its offices;—The construction of the house itself;—The arrangement of the offices;—Their construction;—Out-buildings where necessary;—The accommodations required by the farm-servants and labourers;—By whom the farm buildings ought to be erected;—How they ought to be kept in repair;—and how insured.

1. *General rules for the construction of Farm Buildings.*—In constructing farm-buildings, the following rules ought to be attended to.

Though a circle contains most space, within the smallest possible inclosure, yet, with few exceptions, it is the least adapted for subdivision, and the most expensive in execution; while the square and the parallelogram, will be found the least costly, and the most commodious.

In low buildings, where the roof and joisting are the most expensive articles, the oblong form will be preferable, particularly when such a form is, in other respects, best adapted to the purposes required.

The cheapest buildings are those whose plan is contained within four straight lines. All projections add considerably to the expence, by the extra corners, breaks in the roof, &c.†

To prevent as much as possible the spreading of fire, it is highly important, to have all the cross division walls, in any range of buildings, carried up through the roof, and coped above the covering.

* General Report of Scotland, vol. i. p. 125. Surrey Report, p. 78.

† In the Bedfordshire Report, (p. 20), there are two plans of houses, of equal area, one square, the expence estimated at 733*l.* and the other octagonal, at 671*l.* but except where the houses are very wide, or where wood is very dear, the square shape is reckoned the most economical. It may not be improper to add, that in preparing lime for plastering the inside of a house, it should, when quick, be immersed in *hot* water, instead of cold, which rarifies the air in every particle of the lime, makes it softer to work, and prevents it entirely from blistering.

Farm buildings should be planned according to the size, and the produce of the farm. Grazing and hay farms need few offices; a dairy farm requires more; while an arable one, notwithstanding the invention of the threshing-mill, which contributes to render many large barns unnecessary, must have very numerous accommodations.

Although in buildings of an agricultural description, economy in their execution is an essential point, yet even in these, a person of taste and judgment, will always endeavour to arrange them, so as to give them a good appearance.

2. *Position of the House and Offices.*—The first object, when a new set of farm buildings is to be erected, is to fix on a proper situation, which ought to be as nearly as possible in the centre of the farm, more especially if it be arable. Nothing can be more preposterous, than to continue the old system, of having the farm-houses placed in villages, totally detached from the farm; a plan which originated, from the want of domestic security in feudal times, or the dread of foreign invasion. In many cases, a centrical situation, according to the size of the farm, and other local circumstances, makes a very considerable difference in point of rent. Indeed, if the houses and offices are placed at the corner of a large farm, a part of the land will probably be neglected;—less manure will be sent to it;—the expence of cultivation will be materially increased;—the strength of the horses will uselessly be wasted in going backwards and forwards;—and the remote parts of the farm, will be left in a state of miserable pasturage; or, when occasionally broken up, the crops will necessarily be inferior to what they would have been, under a different system*.

It is sometimes assigned as a reason, for not having the farm-houses and offices in a central situation, that at another part of the farm, a better command of water can be procured, for family use, and for the farm stock, or for driving a threshing-mill, by which a great saving in the labour of horses is secured. That, however, is only an exception to the general rule, for it may be laid down as an axiom, "That the farm-house and offices ought to be placed, as

* It is much to be lamented, that the old mode of open-field tillage, and collecting all the farm-steads of the neighbourhood, into one spot, should still continue in many parts of England. Where this miserable system is persevered in, all the corn must be carted into the village, and all the manure carted back, sometimes up and down steep hills, with immense labour, and an increased wear and tear of the stock and implements.

nearly as possible, in the centre of a farm." Even if water be deficient, it may usually be obtained, by various contrivances to be afterwards explained; (see Sect. IX.) and in general, any difficulty of this kind, may be overcome, upon a large estate, by a new arrangement of the farms.

Where the circumstances of the case admit of it, the farm-house should front the south; for by this means it is less exposed to the cold northerly winds. The farm-stead should be placed on a well-aired and dry spot of ground, and, if it can be had, an elevated situation is always preferable. This is not only the most conducive to health, but an advantage of considerable importance is obtained; namely, it puts it in the power of the farmer, to see what is going forward in every direction*. Where the house, on the other hand, is built in a low and humid spot, the crops of the occupier, however dry and well-conditioned when brought from the field, will soon acquire a softness, and perhaps mustiness, very injurious to their value†. In erecting farm-houses in bleak climates, shelter at the same time, is not to be overlooked, for young stock thrive better in warm-yards, than in exposed places; and in such climates, it is prudent, to guard as much as possible against tempests‡.

3. *Construction of the Farm House.*—The propriety of having suitable accommodations for the farmer, his family, and his servants, in proportion to the rent he pays, need not be dwelt upon. In the construction of the dwelling-house, utility, and not ornament, ought principally to be kept in view; castellated farm-houses, for instance, are evidently absurd and incongruous. At the same time, every landlord of taste, in fixing on the site and plan of a new farm-house and offices, ought certainly not entirely to overlook the embellishment of the country. It is disputed, whether the house ought to have either wings, or a lean-to behind, or whether the whole should not be under one roof. Many think that a house of three stories, the kitchen half sunk, is the driest, the cheapest, and the most convenient. Others prefer, having the kitchen in a wing, attached to the house, which, on the whole, is to be recommended§.

* Husbandry of Scotland, vol. i. p. 20.

† Communications to the Board of Agriculture, vol. i. p. 46.

‡ Kent's Norfolk, p. 112.

§ In exposed situations, where no part of the house is intended to be shaded from the western sun by an adjoining building, the house should front the south, and the south-west angle should be extended to contain the

A farm-house ought not only to be convenient, but should have such a degree of neatness and uniformity, that an idea of comfort and happiness may be given. It should have a little plot of garden ground or shrubbery either before, or behind it. In the latter case, it is placed more distant from the effluvia of the dunghill. In the former, the offices, servants, and cattle, are more immediately in sight. The windows should be large, and the sashes should be placed rather nearer the outside of the wall, than is usual; because, if wet, they will, in that case, sooner become dry. The house should be at a moderate distance from the offices, not only for the sake of purer air, but that the risk of setting the offices on fire, by sparks from the chimnies of the house, may be avoided*. This is another argument for having the garden between the house and the farm-yard.

4. *Arrangement of the Offices.*—The proper arrangement of farm offices, when first built, is of essential consequence, for any blunder committed in this respect, can seldom afterwards be remedied. Peculiarities in the situation, such as a run of water for turning a threshing-mill, declivity of ground, &c. will occasion a variety in the arrangement; but that set of offices, can alone be said to be laid out to the best advantage, where the buildings are so placed, as to carry on the business of the farm in the most economical manner. Thus, easy access from the stack-yard to the barn;—from the barn to the granary;—the proximity of the straw-house, and turnip store-room, to the feeding-houses, straw-yards, &c.;—a ready access from the road to the cart-sheds, farm-stables, and other offices;—together with proper shelter and exposure, constitute the chief requisites in the arrangement. By arranging the offices properly, more labour can be obtained from the servants, while every operation on the farm, is carried on with more facility and dispatch.

5. *Construction of the Offices.*—Nothing is more injudicious, than to have farm buildings huddled together, round so small an area, as from 60 to 70 feet. Where a farm contains from 300 to 600 acres, the area of the offices should not be less than from 100 to 150 feet square, formed into divisions, that the stock kept may be more equally fed. If

kitchen, leaving a passage, or common entrance, west, between the kitchen and parlour. In this case the dairy and cellar, larder and store-room, may be commodiously shaded from the south and west, and thorough-air may be obtained from the passage.

* Communications to the Board of Agriculture, vol. i. p. 7.

it be found expensive to surround the square with buildings, a simple wall may afford shelter, till it is found convenient to enlarge the farm-yard. In fact, none but a practical farmer, who has had a large crop, and a number of cattle maintained during the winter, and who has seen the farm-servants, carelessly driving the cattle and carts in confined court-yards, can fully appreciate the advantages of having his offices with a large area.

Though farm-offices should afford ample convenience to the occupier, for carrying on his business, yet all superfluous buildings ought to be cautiously avoided. Those enormous barns, usually attached to many English farms, are on that account exceptionable; for grain in the straw, keeps infinitely better in the open air, than in close barns; and when it is put in stacks, it is less apt to be destroyed by vermin, there is less risk of fire doing great damage, and the expence of repairing, as well as constructing great barns, is saved*. Threshing-mills, when generally introduced, will render the erecting, and the supporting such buildings unnecessary.

6. *Out-buildings.*—In large farms, cattle-sheds, and other buildings, are often necessary at a distance from the house. The carting of green crops to the central set of offices, and conveying back the manure to remote fields, are attended with such great inconvenience, and such ruinous expences, that it is highly expedient, to have cattle-sheds dispersed over every part of an extensive occupation, and sometimes even extra barns are requisite.

7. *Accommodation for Farm Servants and Labourers.*—The habitations of labourers employed in husbandry, consist either of cottages attached to farms, for the accommodation of the servants employed in them, or the houses of day-labourers. They constitute a description of buildings peculiarly interesting, from their belonging to such valuable classes of the community.

In regard to the houses of farm-servants, they should be situated at a convenient distance from the offices, and have a small garden attached to each of them. In the improved districts of Scotland, married servants are commonly permitted to have cows and pigs; and where their cows are not kept with those of their master, in the cow-house of the

* To large barns there are many objections. If corn is damp, when put in a barn, it is more liable to heat and settle, and more difficult to turn over. Indeed in a late and wet climate, where corn can hardly keep in a stack, it is infatuation to put it in a barn.—*Curwen's Report*, p. 84.

farm, sheds are placed for them, either against the back wall, or at the end of the range of cottages where these servants reside*. The cottages of day-labourers in Scotland, are of a similar description with those of the farmer's servants; but in England, they are often constructed with peculiar neatness and attention.

Cottages are built either with two floors, or with only one. The former mode is very general in England, the latter is more prevalent in Scotland, being supposed warmer, and less liable to have the roofs damaged by the violent winds so frequent in that country.

For the sake of economy, cottages are usually erected in a line, by which mode, one gable answers for two cottages. The inhabitants of cottages, also, when they are contiguous, can furnish assistance to each other, in cases of accident or sickness.

Wherever there are quarries of thin flat stones†, and materials for common roofs are dear, cottages with arched roofs have been recommended‡. They are not only dry, warm, and comfortable, but, when once erected, likely to last for ages§. Where slates cannot be obtained at a low price, a coat of Roman cement, plastered over the arched roof, will preserve the building equally dry and durable‖.

Where cottages have upper chambers, and thin roofs of tile or slate, they are so excessively hot in summer, and so very cold in winter, as to be scarcely habitable. If there are upper chambers, therefore, some are inclined to prefer a thatched roof¶. Were it not for the tax on bricks, arched roofs might be made of them, at a moderate expence, and not liable to any particular objection.

8. *By whom Farm Buildings ought to be erected.*—The value of an estate is so considerably augmented, by commodious buildings, that the owner, who has a permanent interest in the soil, ought to be at the expence of making so substantial an improvement. But this cannot in some

* General Report of Scotland, vol. i. p. 128.

† Thin flat stones employed in a roof, are much improved, by the practice adopted in Dumfries-shire, of painting over with coal-tar, or coal-oil. A covering that was almost useless in a moist climate, is thus rendered impervious to water; and straw roofs being thence rendered unnecessary, a great addition is made to the dunghill.—*Dumfries-shire Report*, Appendix, p. 507.

‡ In Monmouthshire, they build two cottages, one above another, and the lower one is arched.—*Report*, p. 28.

§ General Report of Scotland, vol. i. p. 130.

‖ Remark by Mr. Middleton.

¶ Middlesex Report, p. 41.

cases be effected, where the estate is entailed, and the landlord has only a life-interest in the property. Sometimes the tenant has a greater command of ready money than the landlord, and he generally can lay it out with more economy, and to more advantage. In such a case, it may be advisable for both parties, to arrange a plan, by which the buildings are to be erected at the expence of the tenant, the farm being let at a rent proportionably lower, according to the extent of the buildings required. In other cases, when the tenant undertakes the construction of the farm buildings, the landlord agrees to make an allowance of the first, the second, and in some cases, even the third year's rent, for that purpose.

Many an industrious farmer, however, has got the character of being a bad husbandman, from having been unguardedly led, to exhaust his capital so much on buildings, as to disable him from applying an adequate proportion of it, to the purchase of proper stock, or to the cultivation of the soil. And it may be laid down as a maxim, that though a farmer is well entitled to accommodations, in proportion to the size and produce of his farm, yet to erect these, on a larger scale than circumstances require, is wasteful prodigality. Above all, increasing the expence, by making ornamental erections, cannot be too cautiously avoided. It ought to be considered, that the repair of buildings upon a farm, is a heavy burden upon an occupier during his lease, and especially at its conclusion, when he is necessarily obliged to put the whole in a good condition. A farmer, without doubt, is entitled to comfortable and convenient buildings, if they are not upon the premises when he enters into the farm; but in their erection, a prudent economy ought never to be neglected*.

9. *By whom the Farm-houses and Offices ought to be kept in Repair.*—The repairs may be done, 1. By the landlord; 2. By the tenant; or, 3. At their joint expence.

1. When the landlord is to support the buildings, there is often too little attention paid by the tenant to trifling repairs, which would frequently save much greater charges afterwards. When they are chiefly done at the cost of the landlord, they are estimated, on an average, at 10 per cent. of the rent, including materials†. They are in some cases, however, so enormous, that on one estate, where the rent

* Coventry's Discourses, p. 52. † Kent's Norfolk Report, p. 111.

was 15,000*l.* a year, they amounted, in eleven years, to 40,000*l.**

2. The repairs of farm-houses and offices, in the greater part of Scotland, are usually done by the tenant†. It is a great addition to the incomes of the Scotch proprietors, to be exonerated from so heavy a charge, and it is not found to be attended with any material loss to the tenant. The buildings, at least in the more improved districts of Scotland, are, in general, substantial, which the climate renders necessary; and the materials being good, the houses are more easily supported.

In Ireland, very little attention has hitherto been paid to render farm-houses or offices either comfortable, or commodious. There are but few instances of landed proprietors having made any allowance for improvements, and much fewer, of the tenant being remunerated for any necessary or useful expenditure. The tenant is thus incapacitated from turning his farm to the greatest profit, when he is obliged to expend, perhaps a large part of his capital, unconnected with the improvement of the soil‡.

3. Some persons think, that the tenant should be at half the expences of workmen's wages, (which would interest him in the preservation of the buildings), and that the landlord should furnish materials, and be at the remainder of the expence§. Others recommend, that the materials should be provided, and the repairs done by the tenant, at the joint and equal expence of himself and his landlord. It is rather more usual for the landlord, to put the buildings into a proper state of repair, at the tenant's entry; and for the tenant, (who is frequently furnished with rough timber for that purpose), to leave them in that state at his departure.

The engraving (No. I.) will give *a general idea* of the arrangement best calculated for the interest of the farmer, in regard to his house, gardens, cottages for his farm-servants, farm-offices, and stack-yard. To enter into details, would far exceed the limited size of this publication.

10. *Insurance of Farm Buildings.*—This is a material object both for the landlord and tenant; and a stipulation to

* Suffolk Report, p. 10. In England, the expence of erecting or repairing farm-houses and offices, is in general regulated by the custom of the estate. If the landlord finds materials, it is not without stint or controul; and if the tenant is bound to pay the labour, he cannot be compelled to erect large and unnecessary buildings, against his will.

† Husbandry of Scotland, vol. i. p. 26.

‡ Remark by Edward Burroughs, Esq.

§ Kent's Norfolk, p. 116.

that effect ought to be inserted in every lease. As it is attended with trouble and expence to the tenant, to be annually going to insurance offices, it is better that the landlord, should insure all the buildings on his estate, which might be included in one general policy, and probably at a cheaper rate. Means should also be taken, to preserve the buildings from the effects of lightning*.

Sect. IX.—*Command of Water.*

Those who have a command of good water, can have no conception of the miseries which attend the want of it; or which are experienced, when this necessary article, can only be had in small quantities, or of inferior quality. In the low districts of Lincolnshire, the water is almost every where brackish, and good river, or spring-water, is in such request, that carts are sent for it, in some cases, as far as even sixteen, or seventeen miles†. In the Wolds of Yorkshire, there are instances still in recollection, before the improved mode of making artificial ponds was discovered, of numbers of animals having perished of thirst‡; and in Hampshire, from the long continuance of dry weather, during the autumnal months, the wells became so exhausted, that great labour and expence were incurred, in supplying the family and the stock, by means of water-carts§. To avoid the risk of such serious misfortunes, it was anciently the practice, for the conveniency of having water, to erect farm-buildings in low grounds, near brooks or rivers. This plan, however, was attended with several disadvantages. The house became damp; the grain, from the moisture of the atmosphere, was frequently injured, and, from the vicinity of the water, accidents of various descriptions fre-

* For this purpose, it is recommended by Professor Jameson of Edinburgh, that an iron or copper rod, three quarters of an inch in thickness, and pointed at both extremities, should be placed so, that the top shall project over the highest part of the building, and the lower end to go below the house, and be connected with the nearest piece of water. All the metallic parts of the roof should be connected with the rod, and as chimnies, owing to the charcoal and soot they contain, are good conductors, the rod should be placed near them, but *always higher.*

† Lincolnshire Report, p. 16. ‡ East Riding Report, p. 218.

§ Hants Report, p. 48. The scarcity was so great, that it was said, "There is more strong beer than water within the boundaries of the parish."

quently occurred*. When the advantages, therefore, of having a house and offices in the centre of the farm, and rather on an elevated situation, came to be generally understood and admitted, various modes of obtaining a supply of so essential an article as water, were devised. The chief are, 1. From the roofs of the buildings; 2. Natural springs; 3. Wells; 4. Artificial ponds; or 5. Artificial rills.

1. *Roofs of Buildings.*—Water for common purposes, may be obtained in most situations, by collecting the rain which falls upon the buildings occupied by the family and their cattle; and the means of freeing it from every impurity, are simple and easy†. The buildings and yards of a farm, are supposed to receive rain sufficient, if duly collected, to supply both the family and the cattle of the place, for a considerable part of the year; and ponds, where necessary, may be made in any situation, at a very small expence, for the remainder. Cattle, therefore, ought not to be driven to water beyond the limits of their pasture; and it is not requisite to be fetched in carts from distant places‡.

2. *Natural Springs.*—Where natural springs are to be met with, they will generally furnish a sufficient supply for family use; but they are seldom adequate to the necessities of a great farming establishment. If sufficient attention, therefore, has not been paid to the collecting of water from the roofs of the farm-buildings, in that case wells, or ponds, must be resorted to§.

3. *Wells.*—In Middlesex and Surrey, they have dug wells to a considerable depth, (from 100 to above 560 feet), be-

* Shropshire Report, p. 29; Bedfordshire Report, p. 19; Worcestershire Report, p. 20. How preposterous, to erect farm-buildings and barn-yards, in low, marshy and boggy spots, fit only for the resort of frogs and wild ducks.—*Communications to the Board of Agriculture*, vol. i. p. 44.

† It may be done by two water butts, placed on different vessels for filtrating the water by ascent. From the filter, it should be conveyed to a *tank* under ground, and there it may be preserved for use. When any of this water is wanted, it must be raised by a pump, as is usual in the case of a well. Those who live in countries abounding with water, have no conception of the importance of such hints, to districts inadequately supplied with that essential article.

‡ Remark by Mr. Middleton. See an instance of roof-water being collected.—*Derbyshire Report*, vol. ii. p. 14.

§ There are few springs like that of St. Winifred in Flintshire, which, according to an accurate experiment, emits water at the rate of 120 tons a minute, and in the short space of one mile and 274 yards, is the agent by which eleven mills, of complex machinery, are driven.—*North Wales Report*, p. 75.

fore they could procure water*. In Essex they have been obliged to go as deep as 500 feet, to obtain water of a good quality, and, at that depth, they succeeded. In Hampshire they have likewise dug from 300 to 400 feet in depth, through dry, cracked, or fissured chalk rock, and thus have been able to supply whole villages with water, except during the autumnal droughts†.

4. *Artificial Ponds.*—In several parts of England, as in Hampshire, in Lincolnshire, and in Norfolk‡, artificial ponds have been formed with varied skill and success. In Gloucestershire, such ponds are made, either of a square or a circular shape, and generally so situated, as to furnish a supply to four fields. Three layers of clay, free from the smallest stone or gravel, are so worked in, as to form an impenetrable cement. The whole is afterwards covered with sand, and finished with pavement§. In Derbyshire, artificial *meers*, or cattle ponds, are made in their dry rocky pastures, with great success. Having selected a low situation for the purpose, they deepen it ten or twenty yards across, and spread over the whole excavation a layer, about five inches thick, of refuse slacked lime and coal cinders; then they spread, trample, and ram down, a stratum of well-tempered clay, about four inches thick; and upon this they place a second bed of clay, in a similar manner, of the same thickness; the whole of the bottom and edges of the meer, is then paved with rubble stones; and small rubble stones, several inches thick, are spread upon the pavement‖.

A most ingenious, as well as economical mode of making reservoirs of water, was invented about the year 1775, by Robert Gardener, a well-sinker by profession, born at Kilham, in the East Riding of Yorkshire. Prior to the introduction of his plan of making artificial ponds, many parts of the Yorkshire Wolds were scarcely habitable. But by the ingenuity and exertions of one individual, the difficulties which lay in the way of the improvement of an extensive district, have been removed¶. They are now universally to

* Middlesex Report, p. 34, note; Surrey Report, p. 70.—Lord Spencer's well at Wimbledon, is 563 feet deep.—*Manning's History of Surrey*, vol. iii. p. 272.—Aikin's Hist. of the Environs of London, 1 vol. 4to. printed an. 1811, p. 127.

† Hants Report, p. 48.

‡ Hants Report, p. 47; Lincolnshire Report, p. 17; Norfolk Report, p. 15.

§ Gloucestershire Report, p. 31. Some ponds at Holkham, done in the Gloucestershire fashion, cost 28*l.* each.

‖ Derbyshire Report, vol. i. p. 494.

¶ East Riding Report, p. 218.

be met with in the East Riding, and are widely extended into the North Riding, in situations that require such accommodations*. A description of this useful discovery will be given in the Appendix, No. III.

Ponds are much more eligible than wells, for watering stock, the water being considered wholesomer, and much labour being saved. Few servants like the trouble of drawing water from wells. When stock, therefore, depend upon water from wells, they are likely to have too much water at one time, and to be ill supplied at another. Ponds for stock, are best situated on elevated situations, being then less apt to be injured by dirt running into them†.

5. *Artificial Rills.*—In the North Riding of Yorkshire, there is a tract, extending for many miles, entirely destitute of water, except what flows along the bottoms of the deep valleys by which it is intersected, and little relief could consequently be afforded by streams thus distantly and inconveniently situated, to the inhabitants of the uplands, or their cattle. About the year 1770, a person of the name of Ford, devised the means of watering this district, by means of rills brought from the springs that break out at the foot of the still loftier moorland hills, that run parallel to, and to the north of this tract, in some instances at the distance of about ten miles.

These springs he collected into one channel, which he carried, in a winding direction, about the intervening tract, according to its level, and along the sides of the valleys, until he gained the summit of the arid country which he wished to supply with water; and when this was accomplished, the water was easily conveyed to the places desired, and also to the ponds in all the fields, over a considerable tract of ground.

The plan of thus watering a dry upland country, has much merit. It is not expensive, the original charge rarely exceeding 100*l.* per rill, while it affords a most important accommodation to the occupier, and the value of the property is thereby greatly increased. Though not generally applicable, this plan might certainly be adopted, with great advantage, in some other situations‡.

It remains to state, how farm-yards and fields, may best be supplied with water, in the abundance that is necessary.

* North Riding Report, p. 242. † Wilts Report, p. 13.

‡ North Riding, p. 241. It would be a great advantage, by such artificial rills, to convey water sufficient for the use of a threshing mill. But this can hardly be done, without a considerable *tank* or reservoir.

Water in Farm-Yards.—When cattle are fed in winter on dry food, as hay or straw, no expence should be spared, in supplying them with a sufficient quantity of water. It has been ascertained, that a bullock, feeding upon straw, having water at command, will drink of it eight times a day: hence it is evident, that he cannot get enough, if only driven twice a day to an adjoining stream or pond. It is therefore advisable, where it can be done, to bring water into a cistern in the fold-yard, to which the cattle may go whenever they are in want of it. The cistern may be made of rough masonry, and consequently would not be expensive. There can be no doubt, that cattle will improve much more rapidly, more especially on coarse fare, when thus supplied with water, than if they were only occasionally driven to it*.

In Derbyshire, cisterns hewn out of large blocks, are not only placed in most cattle-yards, but also in the fields, where the springs on the sides of the hills admit of supplying them. Many of them are so placed, that cattle can approach them on either side, and can avoid being injured by a master beast attacking the others when drinking. For conveying the water to the cisterns, thin *zinc* pipes are sometimes used, as being cheaper. When the water enters at one end of the cistern, level with the surface, and passes off at the other, from the constant change and agitation of the surface of the water, by this stream across it, the cistern is not so apt to be frozen, even in the severest weather, which is an object of much importance to the health of the cattle†.

Fields.—A supply of water, is also an object of great importance, in every field where pasturage is intended. With that view; if there happens to be a small rivulet in the neighbourhood of the lands, it may often be distributed in branches, so as to water many fields. Springs, or the collected discharges from drains, may also be applied to the same purpose. All land used for grazing, requires to be constantly well supplied with water.

In conducting water through fields, it is of material importance to take care, that the slopes be gentle, and not more than sufficient for easy transmission; as, when water is conveyed down fence ditches, or open conduits of consi-

* See an account of Mr. Dudgeon of Prora's interesting experiment.—*Husbandry of Scotland*, vol. i. p. 100.

† Derbyshire Report, vol. i. p. 495.

derable declivity, it is too apt to do injury in its progress, by washing away the sides of its channels. Sometimes water is collected in a field, not only for the use of the animals pastured there, but also to be afterwards diverted for other uses, as for threshing and other mills, for irrigation, for ponds, for bleaching, and similar purposes. To accomplish these objects, and at the same time to prevent injury from this element, the drains, conduits, sluices, bridges, gates, and fence ditches, require to be designed with skill, and constructed with scientific attention.

Sect. X.—*Size and Shape of Fields.*

It is of great advantage to the occupier, when his fields are of a proper size and shape; and a loss must inevitably follow, when they are laid out arbitrarily, without attention to any particular system. Where a whole farm is divided into fields of various sizes, it is difficult to form a plan, so as to suit a regular rotation of crops, or to keep very accurate accounts. Whereas, by having the fields *in general* of a large size, the whole strength of a farm, and the whole attention of the farmer, is directed to one point; while an emulation is excited among the ploughmen, when they are thus placed in circumstances which admit their work to be compared. Some small fields, are certainly convenient on any farm, for grazing, and other purposes to be afterwards explained. On elevated situations also, the shelter derived from small enclosures, is of use.

Nothing, however, is more inconvenient, in corn farms, than to have a number of small enclosures, irregularly shaped, surrounded with trees or high hedges, more especially in a flat country, where shelter is unnecessary. Besides the original expence of making the enclosures,—the injury done to the crops of grain, produced by the want of a free circulation of air;—and the harbour afforded to numbers of small birds,—the very site of numerous hedges, with their attendant ditches, and the uncultivated slips of land on both sides of them, consume a much larger proportion of arable land, than is commonly imagined. Hedges, especially if accompanied by rows of trees, greatly exhaust the ground of its fertility; nourish weeds, the seeds of which may be widely disseminated; and by the exclusion of air, the harvesting of the crop is carried on more slowly. Even

upon meadow land, small enclosures, encircled by hedges, are injurious, as they prevent the circulation of air for making or drying the hay. Small enclosures, with high hedges and trees, are also extremely injurious to the roads in their neighbourhood.

On the other hand, with fields of a considerable size, less ground is wasted, and fewer fences are to uphold. The crops of grain, being more exposed to wind, can be harvested earlier, and it suffers less from damp seasons. Small enclosures in pasture, are more productive in winter, being better sheltered; but in summer, the larger and the more open the enclosures are, the better; for in hot weather, both cattle and sheep always resort to the most airy places. It is easier also, when they are in pasture, to obtain a supply of water in large fields than in small ones: indeed fields are sometimes so small, that it is very difficult to procure an adequate supply of water, even in winter. But the conclusive argument in favour of large arable fields is this; that where fields are small, much time and labour are wasted by short turnings; and it is now ascertained, "that if fields are of a regular shape, and the ridges of a proper length, five ploughs may do as much work as six ploughs in fields of a small size, and of an irregular shape; while every other branch of labour, (such as dunging, sowing, harrowing, reaping, and carrying in the harvest), can be executed, though not altogether, yet nearly in the same proportion*."

The circumstances on which the size of fields ought to depend, are;—the extent of the farm in which they are situated;—the nature of the soil and subsoil;—the rotations adopted;—the number of ploughs on the farm;—the inclination of the ground;—its being in pasturage or otherwise; and—the nature of the climate.

1. *Extent of the Farm.*—The size of fields ought certainly, in some measure, to depend upon the extent of the possession. In small farms, near towns, from six to twelve acres may be sufficient; but where farms are of a considerable extent, fields from twenty to even fifty acres, and in some particular cases, as high as sixty, may be used to advantage. In general, however, even on large farms, when permitted by local circumstances, fields of a medium size, as from fifteen to twenty-five English acres, are recommended by competent judges.

2. *Soil and Subsoil.*—In dividing a farm into fields, the

* Husbandry of Scotland, vol. i. p. 41.

nature of the soil and subsoil ought to be kept in view. Where the soil is various, it would be proper to separate the light from the heavy. They are not only better calculated for different crops, and different rotations, but are naturally adapted to be cultivated at different seasons. It is unfortunate, therefore, to have soils of a heterogeneous nature, mingled in the same field. But where this partially takes place, for instance, where there are only one or two acres of light soil, to ten or twenty of strong soil, let the following plan be adopted. At any slack time, either in summer or winter, more especially when the field is under fallow, employ two carts and horses, with four fillers, to cover the acre or two of light soil, with the strong soil contiguous, and the soil in the field will then become more uniform. In fields where light soils predominate, the plan might be reversed. This plan, though at first expensive, is attended with such advantages, that whenever it is necessary and practicable, it ought to be carried into effect.

3. *The Rotation adopted.*—It may be considered as a good general rule, to divide a farm, according to the course of crops pursued in it; that is to say, a farm with a rotation of six crops, should have six fields, or twelve, according to circumstances. It is proper to have a whole field, if the soil be uniform, under one crop; and every farmer of experience, knows the comfort of having the produce of the farm, as equal every year, as the soil and season will admit of.

4. *Number of Ploughs.*—It is likewise proper, that the size of fields should be somewhat in proportion to the number of horses and ploughs on the farm. For instance, where six two-horse ploughs are kept, and where it is difficult, from the nature of the soil, to have the fields of a larger extent, sufficiently dry, from 18 to 25 English acres are considered to be a convenient size. With twelve horses, a field of that extent can always be finished in four, or at the utmost, in five days: there is less risk therefore of being overtaken by bad weather, and prevented from completing the preparation of the land for the intended crop. When the fields are of too great an extent, in proportion to the stock kept, a considerable interval must occur between the sowing of the first and of the last part; and it will in general be desirable, to have each field cleared at the same time in harvest. The harrowing also is done more economically, when the field is sown at once, than in several portions; and where rolling is required, that operation being most effectually done across, it cannot well be accomplished till

the field has been completed. Hence the advantages of having the size of the fields, in some degree commensurate to the stock of working animals upon the farm.

5. *Inclination of the Ground.*—It is, however, evident, that the size of the fields, must in some respects depend on the flatness, or the hilly shape of the ground. Even on dry land, if there be a rise on the ground, from fifteen to twenty chains is sufficient length; for if the ridge be longer, the horses become much fatigued, if compelled to plough a strong furrow up-hill, beyond that length, in one direction. This objection, however, to large fields, may in some measure be obviated, by giving the ridges and furrows, in such fields as are on the side of a hill, such an obliquity, as may diminish the difficulties of the ascent*.

6. *Pasturage.*—Where the system of grazing and tillage is alternately followed, (more especially where the fields are pastured for two or three years in succession), it is convenient, to have the fields of from 20 to perhaps 30 English acres. The farmer is thus enabled to divide his stock, which he cannot well do with larger fields. The cattle or sheep remain more quiet, than if a greater number were collected together; and less grass is destroyed by treading. When such a field has been pastured for some time, the stock should be removed to another, till the grass in the former has renewed, and is fit for being eaten. Such a size also, in general, suits graziers better than larger ones, and consequently fields of this extent, when in pasture, generally let for more rent.

7. *Climate.*—The last circumstance to be considered, in determining the proper size of fields, is, the nature of the climate. In dry and cold climates, small enclosures are desirable, on account of shelter; whereas in wet countries, the fields under culture, cannot be too open and airy, for the purpose of drying the ground, of bringing forward and ripening the grain, and of enabling the farmer more easily to secure it, during an unfavourable harvest, by having a free circulation of air.

But though on large farms, fields should in general be formed on an extensive scale, yet there is a convenience in having a few smaller fields near the farm house, for keeping the family cows;—for turning out young horses, mares, and foals;—for raising a great variety of vegetables;—and for

* Where the hills are steep, horizontal ploughing is to be preferred *on light soils*, because sudden rains are not so apt to enlarge the furrows, and to waste the soil. This plan has been adopted in America.

trying experiments on a small scale, which may afterwards be extended, if they shall be found to answer.

Where enclosures are too large for particular purposes, and where no small fields, as above recommended, have been prepared, large fields may be subdivided by sheep hurdles, a sort of portable fence well known to every turnip grower. In this way, great advantage may be derived, from the constant use of land, that would otherwise have been occupied by stationary fences; and the expence of subdivisions, which, on a large farm, would necessarily have been numerous, is thereby avoided. This fence is perfectly effectual against sheep, though it is not so well calculated for stronger animals. On dry soils, where sheep are generally pastured, it is not unlikely, that by using moveable hurdles, the expence of permanent fences might in a great measure be saved. Iron hurdles, some cast, and others much lighter, made of wrought iron, are also frequently used as temporary fences. If made for sheep, the cast metal is only 7*s*. each, but 9*s*. if strong enough for cattle*.

The shape of fields, may be either square or oblong.

Square Form.—The advantage of having the fences in straight lines, and the fields, when large, of a square form, is unquestionable, as the ploughing of them, under this arrangement, can be carried on with much greater dispatch. Some farmers, whose fields are of a waving or uneven shape, and who enclose with hedge and ditch, carry their fence through the hollows, or best soil, with a view of raising a good hedge, thus often sacrificing, for the sake of the fence, the form of their field. A straight line, however, is preferable, even though it should be necessary to take some particular pains to enrich the soil for the hedge, where it is thin and poor, on any elevation. By means of the square form, an opportunity is afforded, of ploughing in every direction, when necessary; and less time is lost, in carrying on all the operations of husbandry, in a field of that form, than of any other shape. Where the waving form is necessary to secure proper water-runs, plantations may be so disposed, as to reduce the fields to squares or oblongs, and the fences to straight lines. Rectangular fields have another advantage, that in fields of that shape, it may be known, whether the ploughmen have performed their duty, the quantity of work done being easily calculated, from the length and breadth of a certain number of ridges.

* Derbyshire Report, vol. ii. p. 235.

Oblong Form.—When fields are small, an oblong shape should be preferred, that the ploughing may be dispatched with as few turnings as possible. This form has also other advantages. The fields are more easily subdivided, and water can almost in every case be got, by making proper ponds in the meeting or joining of three or four fields, whose gutters, or ditches, will convey water to the ponds. In turnip soils, where the shape is oblong, it is easier to divide the turnips with nets or hurdles, for the convenience of feeding them off with sheep. If the ridges are too long, and the field dry and level, the length may be reduced, by making cross head-lands, or head-ridges, at any place that may be considered the fittest by the occupier.

The same engraving, (No. I.) will likewise explain the best plan for dividing fields on clay land, and turnip-land farms, in square divisions, and the rotations that may be adopted in each.

Sect. XI.—*Farm Roads.*

The profitable occupation of a farm, is essentially promoted, by having the private roads through it, judiciously planned, well formed at first, and afterwards kept in proper repair. Attention to these particulars is often neglected; hence both the landlord and the tenant sustain much injury. These private roads, like other substantial improvements, ought to be made at the expence of the landlord; but if he is unable to advance the money, the tenant ought to be encouraged, to make the necessary exertions, by a premium for every yard he properly executes, or security given him, that he shall be indemnified, to a certain extent, at the termination of his lease.

Where the farm is regularly divided into large enclosures, it is seldom difficult to obtain the advantages of convenient roads, with easy access from the farm-offices, to each field: nor would the making of good roads in any case be difficult, provided a regular plan were adopted for that purpose; materials may be collected, and the stones broken, by the farm-servants, at times, when, from the state of the ground, other operations could not well be executed: and if a rule were laid down, to make a certain quantity of road, from 50 to 500 yards, every year, according to the size of the occupation, the roads, even on a large farm, would thus be progressively gone over, and its value would be materially augmented.

It is particularly necessary, to make a good piece of road at the gate of every enclosure, being the spot which is most frequently in use. Without this precaution, it often becomes a mire, where corn is thrown down and spoiled in harvest, or if it is attempted to avoid the mire, the gate-posts and neighbouring fence are often damaged*.

In order to prevent accidents, it is necessary to have the gates wide, and whatever may be the sort of fence, *to round the corners af the fields*, instead of having them square. By this plan, owing to the facility of turning, many accidents, injurious both to the carts and to the cattle, may be prevented.

The most effectual means, by which either public, or private roads, can be kept in good repair, is, by the use of broad *cylindrical* wheels, which are as well calculated for farming, as for other purposes. A gentleman who has given the experiment a fair trial, states, that no person, whose mind is open to conviction, can use these wheels, without at once perceiving their very great superiority over the narrow conical ones. He is satisfied, that his farm roads will be maintained at one-fourth of the expence that had previously been incurred. In farming operations, their superiority is so great, that he thinks it would be for the advantage of every extensive farmer, to adopt them immediately. He considers them to be the greatest improvement in agricultural machinery, since the invention of the threshing-mill; and he conceives, that every month's delay that takes place in their general adoption, is a great individual and national loss†.

If a farmer be thus accommodated with good private roads, the advantages which result from them are of the highest importance. His work will be performed at much less expence; the labour of the horses will be much easier; —a greater quantity or weight of grain, and other articles, may be more expeditiously carried over them;—manure can be more easily conveyed to the fields;—the harvest can be carried on more rapidly;—and wear and tear of every description will be greatly reduced‡.

* Communications to the Board of Agriculture, vol. ii. p. 251.

† See the substance of a Communication from William Cunningham, Esq. of Lainshaw, in Ayrshire, upon this subject, Husbandry of Scotland, vol. i. p. 67.

‡ Mr. Blaikie, in his Observations on the Economy of Farm-yard Manure, and on other Rural Subjects, has discussed the formation and improvement of roads, with his usual ability; and Mr. Loudon M'Adam's exertions, so important for promoting these objects, will certainly make a new era in the History of Road-making.

Concluding Observations.

Such appear to be the most essential means, for carrying on the successful improvement and cultivation of a farm. It is by attention to these particulars, that a good, is distinguished from a bad farmer; and that the diligent husbandman, lays the foundation of a system, which will prove the source of his future prosperity. For that purpose, it is necessary for him,—to proportion his farm to the capital he can command;—to keep regular accounts;—to establish a judicious arrangement in the cultivation of his farm;—to procure intelligent and industrious labourers;—to rear, or to purchase well-selected stock;—to buy implements, distinguished more by utility than number;—to have his buildings well arranged, and abundantly supplied with water;—and to divide his fields in a regular manner, with roads of communication to them, kept in a proper state of repair. If these particulars be attended to, he has every reason to look for success; but in proportion as they shall be neglected, he may expect to meet with disappointment, and in many cases to experience real loss.

CHAP. III.

ON THE VARIOUS MODES OF IMPROVING LAND.

THE ingenuity of man has, in no respect been more usefully employed, nor, on the whole, been displayed more conspicuously, than in the various modes it has discovered, for rendering the surface of the earth more productive. Not only have extensive tracts of waste land been reclaimed, but by processes about to be described, the culture of the soil has been improved;—the quantity of its produce augmented;—and the quality of that produce amended:—while, by the art of embanking, thousands of acres have been protected from the ravages of a powerful and destructive element. In this Chapter, it is proposed to give *a general view*, of the nature of these several processes, under the following heads: 1. Cultivating and improving wastes; 2. Enclosing; 3. Draining; 4. Manuring; 5. Paring and burning; 6. Fallowing; 7. Weeding; 8. Irrigating; 9. Flooding; 10. Warping; and, 11. Embanking. Any discussion on the means of improving the soil *by planting*, is reserved for the Fourth Section of the subsequent Chapter.

SECT. I.—*Cultivating and Improving Wastes.*

LAND, when uncultivated, yields, from its natural productions, but slender means of subsistence to man. Some fruits,—articles of the nut species;—and the leaves and roots of several plants, may be used as food. The numbers, however, that could be maintained either by these means, or by hunting wild animals fed on natural herbage, or by the flesh and produce of domesticated animals, maintained in the same manner, are but inconsiderable, compared to the millions of human beings, who enjoy the necessaries and comforts of life, when the soil is properly cultivated. The first object, therefore, to be attended to, in procuring food from the soil, is, to bring it into a state of cultivation;

the next, not only to prevent it from being exhausted, but, if possible, to increase its fertility*.

In discussing this subject, it is proposed to consider; 1. The various descriptions of waste lands; 2. The natural obstacles to cultivating and preparing them for the production of crops; 3. The various means of reclaiming such wastes; 4. The rules to be observed regarding this species of improvement; and, 5. The private and the public advantages to be derived from it.

1. *Of the various Descriptions of Waste Lands.*

These may be classed as follow: 1. Mountainous, hilly, or steep grounds; 2. Moors; 3. Bogs, or peat-mosses; 4. Marshes; 5. Warrens, or downs; and, 6. Shores, or beaches.

1. The highest peaks and ridges of mountains, are mostly naked granite, slate, or volcanic productions. Their more elevated sides, and the tops of those of moderate height, are usually covered by a thin soil, producing a short dry herbage, which is frequently mixed with a dwarf or stunted heath*. Where the soil is not injured by moisture, these are best calculated for sheep. When the height of mountains exceeds 800 feet of elevation above the level of the sea, unless covered either with natural woods, or artificial plantations, they can only be profitably used in pasture.

The hills, or land less elevated than mountains, have, in general, a deeper and moister soil, and produce a more luxuriant herbage, but of a coarse quality; hence they are better adapted for small hardy cattle. Though the summits of hills are generally unfit for raising grain, yet the plough is gradually ascending along their sloping sides, and within the last thirty years, many thousand acres, in such situations, have been reclaimed in the United Kingdom.

Some steep lands along the sides of rivers, and small streams, still remain in a state of waste, being inaccessible to the plough, and unfit for tillage. The more rugged of these, are well calculated for woods or coppice; while those

* All soils, by being cropped, have their fertility more or less diminished, and, in process of time, will become no longer productive. Hence the necessity of renewing their powers by manures of various descriptions. Some lands have borne crops of corn for a number of years, without their showing any signs of exhaustion. But such soils have, in general, something peculiar in their situation, composition, or subsoil, or the ingredients of which they are composed, as to give them such a peculiar property.

† Communication by John Middleton, Esq.

in more favourable situations and climates, may be converted into orchards*.

2. Moor-lands are of various descriptions. Sometimes they are in low and mild situations, where the upper soil is thin, or scantily supplied with vegetable mould; and where the bottom, or under-stratum, is impervious and barren. These, in general, may be reclaimed with more or less advantage, according as they are near manure, or markets, and other means of improvement.

Others, on the contrary, are in situations much elevated above the level of the sea; where the surface is covered with heath, and other coarse plants, and frequently encumbered with stones. Such moors are seldom worth the expence of cultivation, and from their height, are only calculated, either for woods or pasturage.

Moors, however, which are not placed in high or bleak situations, and where the surface is close-swarded, or covered with plants, and where the subsoil is naturally, either not altogether wet, or capable of being made sufficiently dry at a moderate expence, may not only be reclaimed, but often can be highly improved. Indeed where such lands are to be met with, they ought on no account to be suffered to remain subject to commonable rights, and comparatively useless to the country, as they are capable of being reclaimed, and if allotted and enclosed, might be rendered highly productive.

3. Bogs, or peat-mosses, occupy no inconsiderable portion of the surface of the British Isles†. They are of two

* Coventry's Discourses, p. 101.

† The extent of peat soil in Ireland is very considerable. The following is its estimated amount:

	English acres.
1. Flat red bog, capable of being converted to the general purposes of agriculture	1,576,000
2. Peat soil covering mountains, capable of being improved for pasture, or beneficially applied to the purposes of plantation	1,255,000
Total	2,831,000

See 2d Report, on the State of Disease, &c. in Ireland, printed by the House of Commons, 7th June, 1819, Appendix, p. 156. In the Appendix, there are a number of valuable hints, on the means of improving the bogs of Ireland, from which the practicability, and the utility of that system, is clearly proved, and the great probability, if not the certainty, that it would be attended with profit. Mr. Griffiths, junior, recommends, as the best rotation for such land, 1. Rape for seed; 2. Potatoes in drills; 3. Oats, with grass-seeds; and, 4. Meadow. This rotation, he is of opinion, would yield as much produce, as would pay for the expence of bringing the lands into

sorts, one black and solid, the other spongy, containing a great quantity of water, with a proportion of fibrous materials.

Black mosses, though formerly considered irreclaimable, are now found capable of great melioration. By cultivation, they may be completely changed in their quality and appearance; and from a peaty, become a soft vegetable earth of great fertility. They may be converted into pasture;—or, after being thoroughly drained, thriving plantations may be raised upon them;—or, under judicious management, they will produce crops of grain and roots;—or, they may be formed into meadow-land, of considerable value*.

Flow, fluid, or spongy mosses, abound in various parts of the British Isles. Such mosses are sometimes from ten to twenty feet deep, and even more, but the average may be stated at from four to eight. In high situations, their improvement is attended with so much expence, and the returns are so scanty, that it is advisable to leave them in their original state; but where advantageously situated, it is now proved, that they may be profitably converted into arable land, or valuable meadow. If they are not too high above the level of the sea, arable crops may be successfully cultivated. Potatoes, and other green crops, where manure can be obtained, may likewise be raised on them with advantage†.

Peat is certainly a production, capable of administering to the support of many valuable kinds of plants. But to effect this purpose, it must be reduced to such a state, either by the application of fire, or the influence of putrefaction, as may prepare it for their nourishment. In either of these ways, peat may be changed into a soil fit for the production of grass,—of herbs,—or of roots. The application of a proper quantity of lime, chalk, or marl, prepares it equally well for the production of corn. But in cases

a fertile state, and cultivating them afterwards. It is said, (Report, p. 168), that rye is frequently good, when other crops fail.

Mr. Burroughs observes, that since an additional duty has been imposed on foreign rape, that article would pay well; and no crop is more abundant, or less precarious, on boggy soils.

* See Chap. I. Sect. 2, where mention is made of such lands, when improved, becoming, under judicious management, perpetual meadows. In regard to manure for such soils, it has been remarked, that the peat, whose texture is the least fibrous, and which has the least porosity, is the most easily divided, and is best calculated for putrescent manures. The fibrous peat, requires the application of lime.

† Dr. Coventry recommends the drainage of flow-mosses, for several years before their cultivation is attempted.—*Discourses*, p. 110.

where peat is too wet for the production of fine grass or good corn, the first operation is, to drain it completely*; and then to supply it with calcareous, and putrescent manures.

4. Marshes, or water-fed lands, are of two descriptions, one formed by fresh, and the other by salt water.

Fresh water marshes are often found interspersed with arable land, where springs rise, and redundant water has not been carried off; and may be improved by a course of ditching, draining, and ploughing. Where large inland marshes are almost constantly covered with water, or the soil is extremely wet, they may be drained, as large districts in the fens of Lincolnshire have been, and made highly valuable. The object, in that case, is, by embankments, draining, and other means of improvement, to convert these marshes into pasture, or meadow, or even arable lands. Where such improvements cannot be accomplished, the most useful aquatic plants, as willows, oziers, &c. may be propagated, either by their seeds or roots, with much advantage to the cultivator†. Some have strongly recommended, on such wet and low lands, the fiorin grass; others the "*poa aquatica*," which would answer well where the soil is clay, and where it lies under water all the winter.

In regard to salt water marshes, embankments are the only means by which they can be improved; and they might be rendered of thrice their present value, if spring tides could be prevented from overflowing them. They are in general deficient in pasture, but that pasture operates as a medicine to diseased cattle, or those abounding with humours; acting as salts upon the human frame, being purgative, but not nourishing‡.

5. Sandy downs on the sea shore, are often more valuable, *in their natural state*, than after cultivation. In a state of nature, they frequently afford good pasture for sheep and rabbits, and at other times, produce grasses that may be used as food for cattle, or as litter. But the great object should be, to raise plants which contribute to fix these soils, and

* Communication from John Middleton, Esq.

† Coventry's Discourses, p. 114.

‡ It is difficult to improve land, which has been covered by the sea at every neap tide. A field of this sort has been fenced off from the sea near Exmouth, and for seven years it would not produce either corn or grass, or even pulse of any kind; indeed it still remains perfectly barren, yet the earth seems fine, and rich in quality.

There must have been something peculiarly deleterious in the sea salt with which it is saturated.—*Remark by the Rev. Robert Hoblyn.*

to prevent them from being drifted by the winds, which often occasion incalculable mischief*.

On poor sandy soils, in inland districts, rabbits are the usual stock. Many warrens have been cultivated for raising crops of grain; but rabbits would frequently pay better. It would often be more profitable, therefore, to convert them again into warren, or where wood is valuable, to plant them with fir.

6. Along the banks of lakes and rivers, as well as the sea-shore, there are extensive tracts, in a waste state; and likely to remain neglected, from deficiency of soil. Where the land, however, is composed of alluvial particles, it may be embanked, and afterwards improved by the usual operations of agriculture.

2. *Natural Obstacles to the Cultivation of Wastes.*

The chief natural impediments to the cultivation of wastes are, 1. Woods; 2. Shrubs, or woody plants; 3. Fern; 4. Heath; 5. Coarse herbage; 6. Stones; and, 7. Rocks.

1. *Woods.*—The growth of large trees, though a great impediment to cultivation, is a sign that the soil is naturally fertile. It must also have been enriched, by the quantity of leaves, which, in the course of ages, have fallen and rotted upon the surface. Such are the beneficial effects of this process, that after the trees have been cut down, the soil has often been kept under crops of grain for a number of years, without interruption, or any addition of manure. Land thus treated, however, ultimately becomes so much reduced, by great exhaustion, that it will not bear a crop worth the expence of seed and labour†. It is evident, however, that this deterioration, entirely proceeds from the improvident management previously adopted.

In reclaiming such wastes, the branches of any trees that are felled, are generally collected and burnt; and the ashes are either in whole or in part, spread on the ground, by which the fertility of the soil is excited. Indeed, where there is no demand for timber on the spot, nor the means

* Coventry's Discourses, p. 116. They pay much attention, in several parts of the Continent, in particular on the shores of the German Ocean, to prevent these "*sand-floods*," as they are termed. A small rivulet, or the planting of the *juncus arenaceus*, are found to be the most effectual barriers against their encroachments.

† Communications to the Board of Agriculture, vol. ii. p. 257.

of conveyance to any advantageous market, the whole wood is burnt, and the ashes applied as manure.

In various parts of England, much coppice land has been grubbed up, and brought into tillage*. In Oxfordshire, the temptation is considerable, as from 30*l.* to 35*l.* per acre may be obtained, and the land left in a state fit for the plough†. Sometimes woods are grubbed for pasture merely. In that case the ground should be as little broken as possible, because the surface of the land, owing to the dead wood and leaves rotting time out of mind upon it, is much better than the mould below. It soon gets into good pasture as grass land, without sowing any seed‡. But by far the most eligible mode of converting woodland into arable, is merely to cut down the trees, and to leave the land in a state of grass, until the roots have decayed, cutting down with the scythe, from time to time, any young shoots that may arise. The roots, in this way, instead of being a cause of anxiety and expence, as they generally are, become a source of improvement; and a grassy surface is prepared for the operation of sod-burning§. Wherever it is practicable, the land should be well limed, which will greatly increase its value‖.

In Scotland, natural woods and plantations have been successfully grubbed up. In the Lower Torwood, in Stirlingshire, many acres of natural coppice were cleared, at an expence of from 15*l.* to 20*l.* per acre; and the land is now become as valuable as any in the neighbourhood¶. On the banks of the Clyde and the Avon, coppices have been cut down, and after being drained, cultivated, and manured, the land has been converted into productive orchards.

In Perthshire also, several thousand acres of plantations have been rooted out, the soil subjected to the plough, converted into good arable land, and profitably employed in tillage**.

* Hants Report, p. 297; Annals of Agriculture, vol. ii. p. 412.

† Oxfordshire Report, p. 221.

‡ Communications to the Board of Agriculture, vol iv. p. 42.

§ Marshall's Yorkshire, vol. i. p. 316. In Oxfordshire, on the other hand, owing to the great scarcity of fuel, the roots pay one half of the expence. *Report*, p. 223.—In America, they find, that the roots of the maple and the beech, decay of themselves in four or five years. The roots of the oak require a longer period.

‖ Remark by John Middleton, Esq.

¶ Stirlingshire Report, p. 213.

** Perthshire Report, p. 329. It is advisable to leave the roots, where they are not worth the expence of removing, only boring a hole in the middle, which brings on rottenness, even in two or three years.

2. *Shrubs.*—Land covered with furze, broom, and other shrubs, is, generally speaking, well adapted for cultivation. Furze, or whins, (*ulex europæus*), will thrive in a dense clay soil; and where they are found in a thriving state, every species of grain, of roots and grasses, may be cultivated with advantage. The broom, on the other hand, prefers a dry, gravelly, or sandy soil, such as is adapted for the culture of turnips. A large proportion of the arable land, in the richest districts of England and Scotland, was originally covered by these two plants; and vast tracts still remain in that state, which might be profitably brought under cultivation. For that purpose, the shrubs ought to be cut down, the ground trenched, or the plants rooted out by a strong plough, drawn by four or six horses, and the roots and shrubs, (if not wanted for other purposes), burnt in heaps, and the ashes spread equally over the surface*. In many places, shrubs and brushwood may be sold for more than the expence of rooting them out. When coal is not abundant, and limestone, or chalk can be had, the furze should be employed in burning the lime that is used in carrying on the improvement†. It requires constant attention, however, to prevent such plants from again getting possession of the ground, when it is restored to pasture. This can best be effected, by ploughing up the land occasionally, taking a few crops of potatoes, turnips or tares in rows, and restoring it to be pastured by sheep. In moist weather also, the tender shoot of every shrub, as it arises, should be pulled up and destroyed‡.

3. *Fern or Brakes*§.—This is a very troublesome weed to extirpate, as, in many soils, it sends down its roots into the under stratum, beyond the reach of the deepest ploughing; but it is a sign of the goodness of any soil, where it grows to a large size. June or July are the best seasons for destroying it, when the plants are full of sap, and when they ought to be frequently cut. They are not, however, easily subdued, often appearing after a rotation of seven years, including a fallow, and sometimes requiring another rotation, and cutting them repeatedly, before their final disappearance can be effected‖. Lime, in its caustic state, is peculiarly hostile to fern; at the same time, it can hardly

* Communications to the Board of Agriculture, vol. ii. p. 260.
† Oxfordshire Report, p. 232. ‡ Remark by John Middleton, Esq.
§ Pteris.
‖ In pasture lands, they have been destroyed, by cutting them twice in the season, by the scythe or hook.—*Remark by Edward Burroughs, Esq.*

be completely eradicated, but by frequent cultivation, and by green crops assisted by the hoe*.

4. *Heath.*—This hardy plant is palatable and nutritious to sheep; and under its protection, coarse grasses are often produced. When young, or in flower, it may be cut, and converted into an inferior species of winter provision for stock. But where it can be obtained, it is desirable to have grass in its stead. For that purpose, the land may be flooded, or the heath burnt in March or April, and kept free from stock for eighteen months, in consequence of which, many new grasses will spring up, from the destruction of the heath, and the enriching quality of the ashes. The improvement is very great; more especially if the land be drained, and lime or compost be applied†. But if the land be too soon pastured, the grasses, being weak and tender, the sheep or cattle will pull them up with their roots, and the pasture is materially injured‡. Where it is proposed to cultivate the land for arable crops, the lime applied, should be in a finely powdered state, highly caustic, and as equally spread as possible§.

5. *Coarse Herbage.*—It is often necessary to burn coarse herbage, before the surface can be pared, and burnt. Some have recommended, making a compost of the pared surface, with lime, or building *folds*, or earthen walls of the sods, which, by the action of the atmosphere, become friable and fertile‖; but these processes are slower, and not so effectual as paring and burning.

In coarse rough pastures, ant-hills frequently abound. A successful experiment has been tried, of mixing these hills with lime; and the compost was found to answer well for barley and grass-seeds¶. But if possible they should be burnt**.

6. *Stones.*—The stones which impede the improvement of land, are either loose, thrown up when the land is trenched

* Oxfordshire Report, p. 234, and 240. The Rev. Robert Hoblyn has completely eradicated fern, by a tedious, but effectual process. He employed a weeding woman to cut off the fern, when young and full of sap, (about five or six inches high), just below the surface of the ground; and another woman, with a basket of old salt, to apply a pinch of it, to the severed and bleeding root. The acridity of the salt destroyed the weed.

† General Report of Scotland, vol. ii. p. 359.

‡ Statistical Account of Scotland, vol. iv. p. 465.

§ Communications to the Board of Agriculture, vol. ii. p. 264.

‖ Ditto, vol. ii. p. 266, 268.

¶ Lincolnshire Report, p. 255.

** Remark by John Middleton, Esq.

or ploughed; or fixed in the earth, and not to be removed without much labour and expence.

Loose stones may often be converted into use, for the purpose of covered drains,—of constructing walls or fences, —or making and repairing the roads on the farm, or in the neighbourhood; and on these accounts, are sometimes worth the trouble of collecting. They may be removed, with the least inconvenience, when the land is fallowed. Where loose stones are of a moderate size, they are sometimes found advantageous rather than detrimental, as in the stone-brash soils of Somerset, and other districts. They prevent evaporation, and thus preserve moisture in the soil. Hence farmers have been induced to bring back again to their corn fields, those very stones they have been induced to carry off*.

Where stones are large, and fixed in the earth, if they appear above the surface, they should be removed before the ploughing of the waste commences: but where they are concealed under the surface, various modes to get rid of them have been adopted. In some parts of Yorkshire, the whole surface is gone over with sharp prongs, which, at the distance of every twelve or fourteen inches, are thrust into the ground, to the depth of about a foot, to ascertain where stones are to be met with. The spot is marked by a twig, and the stones are removed before the land is ploughed. Sometimes the plough is used without such previous examination, and the place marked where stones are encountered, that they may be taken away;—and sometimes, in order to discover and remove such stones, the land is trenched by the spade†.

Stones above the surface, may be avoided by the ploughman, though not without loss of ground; but stones under the surface, are often not discovered till the plough is drawn against them, and perhaps broken, by which a day's work is sometimes lost‡. Clearing the ground from stones, not only prevents such mischiefs, but is attended with actual profit. When removed, they may be used for various purposes, and are often less expensive than if dug, or purchased at a quarry. The soil round a large stone, is likewise, in general, the best in the field, and is bought at a low rate, by the expence of taking out the stone, as the plough has thus access to all the land around it. In stony land, the plough must proceed

* Remark by the Rev. Robert Hoblyn.

† Communications to the Board of Agriculture, vol. ii. p. 253.

‡ A wooden bolt, to unite the horse-trees to the chain of the plough, may prevent mischief by giving way.

slowly, and cannot perform half so much work as it ought to do; but, after such impediments have been removed, the field may be ploughed with the usual facility, and cheapness, and in a much more perfect manner. It frequently happens, that when working stony land, more expence is incurred in one season, by the breaking of ploughs, besides the injury done to the horses and harness, than would cure the evil*.

There are various modes of getting rid of stones. They are generally of such a size as admit of their being conveyed away in carts, or other vehicles calculated for that purpose. Some ingenious artificers have constructed machines for raising them, when of a large size†. On some occasions, pits have been dug close to large stones, and the latter have been turned into the former, at such a depth, as to lie out of the reach of the plough. But it is frequently necessary, to reduce their size, by the force of gunpowder, before they can be removed.

7. *Rocks.*—When rocks interrupt cultivation, recourse must be had to blasting, unless the stone is in thin layers, or beds, and can easily be penetrated by wedges. They must be quarried out to a sufficient depth, and then covered over with earth, to admit the operations of tillage.

3. *Means of reclaiming Wastes.*

There are six modes by which waste lands, according to their nature and situation, are prepared for the production of crops: 1. Paring and burning; 2. Trenching by the spade and mattock; 3. Deep ploughing; 4. Covering the surface with earth; 5. Floating off the surface of peat-bogs, when there is a valuable soil below; and, 6. Rolling, the utility of which, in promoting the improvement of peaty soils, by consolidating their texture, has not yet been sufficiently attended to.

1. *Paring and Burning.*—This operation, and its merits, shall be more fully discussed in a subsequent Section, (No. 5). At present, it is sufficient to remark, that it is

* General Report of Scotland, vol. ii. p. 256; Kames's Gentleman Farmer, p. 58.

† One was invented by the Rev. Mr. Ramsay, of Maderty, in Perthshire, and is described in the Statistical Account of Scotland, vol. xix. p. 565. Another machine has been successfully used by Mr. Spottiswoode, of Spottiswoode, in Berwickshire, originally invented by Mr. Robert Richardson, of Keswick in Cumberland. See Transactions of the Society of Arts, vol. xxvi. p. 190.

greatly to be preferred, to every other method for reclaiming barren land, *where the turf will produce an adequate quantity of ashes**. It is proved by experiment, that it is much less expensive than clearing the land by tillage:—produces better crops;—and leaves the land in a better state for cultivation†. But where the ground is deficient in vegetable matter, or if it be full of stones and rocks, or covered with wood, other means must be resorted to. If it be covered with wood, instead of attempting to burn the surface, the trees and underwood must be cut down, and reduced to ashes, by which some good crops are ensured. Previous to the improvement of land covered with furze, or broom, these plants must be burnt upon the ground, with a view, not only of facilitating their extirpation, but of obtaining the ashes they produce, which, with the ashes from the grass and roots to be found on the surface, will greatly tend to fertilize the soil.

2. *Trenching.*—Where the soil is shallow, and the subsoil hard and stony, it is frequently advisable, after extirpating the worthless plants, to manure the surface, and, without attempting to remove the stones, to convert the land into permanent pasture; but, when there are circumstances which make it advisable, to render this soil arable, the most effectual means of accomplishing that object is, by the spade and the mattock. In that case, if the surface be unfertile, it is laid flat, with the top inverted at the bottom of the trench, where it operates as a kind of hollow-drain. By means of trenching, every stone which can interrupt the future ploughing of the soil, is discovered and removed, either by the usual instruments, or by the application of gunpowder; the ground is deepened to the extent of thirteen or fourteen inches; and as it contains no weeds, it only wants a sufficient quantity of dung and calcareous earth, to put it in a state of vegetation, and to enable it to produce crops of grain. By this plan, more or less perfectly conducted, about 20,000 acres in all, have been added to the cultivated land of one single county, (Aberdeenshire). The process, where stones abound, has been found very expensive, (as high as from 40*l.* to 50*l.* and some cases, 100*l.* per acre); but one half of the expence has often been repaid by the sale of the stones, for paving, or building; and, in the vicinity of the city of Aberdeen, the land has after-

* North Riding Report, p. 208 and 213.

† See an Account of Sir John S. Sebright's Experiments, Herts Report, p. 150.

wards let for 5*l.* per acre*, by which the expence has been indemnified. Land, however, not attended with peculiar difficulties, may be trenched at from 8*l.* to 10*l.* per acre, and even for less†.

3. *Deep Ploughing.*—This method of improving land is applicable to poor clays, covered with heath or furze, and rather wet and stony. The under stratum of such clays, being uncommonly obstinate, it requires at least four, and sometimes six strong horses to make a furrow of sufficient depth. Care also should be taken, to lay the sod or turf as flat on its back as possible, for fifteen or eighteen months, in order that it may be thoroughly rotted. When the soil is dry, lime may be spread upon the surface, and allowed to remain in that state for two years, previous to its being again ploughed. By these means, considerable tracts of waste land have been rendered capable of regular cultivation. But this is a tedious and expensive mode of accomplishing the object.

The most extraordinary improvement by ploughing, was made by the late Mr. Barclay of Ury. The implements he used were uncommonly strong, and he employed six, and sometimes eight powerful horses in the draught. He made the plough to descend, in spite of every obstruction, sixteen or seventeen inches at once: and after carrying off the stones, which were turned up as if from a quarry, he repeated these operations, till in the end he obtained a free soil, cleared of stones, twelve or fourteen inches deep, and fit for every agricultural purpose. Sometimes a thousand cart-loads of stones were removed from one acre, and the surface of the land was evidently lowered several inches, before the improvement was completed‡. So great an expence could hardly be indemnified. Where only small patches of stony land, are in a field, it may be proper to clear them of stones; but as a general mode of improving extensive moors, it is not to be recommended.

4. *Covering the Surface with Earth, &c.*—In England, this mode of improvement has been practised, not only in regard to bogs, but also light sandy soils.

* There is an interesting paper on Trenching, by the Rev. Dr. Skene Keith, in the General Report of Scotland, vol. ii. p. 395.—Mr. Monteath of Closeburn, and Mr. Maclean of Mark, recommend, as a beneficial practice, to trench or delve mossy soils, to bury the light surface, and to bring up the black decayed moss, which is much better calculated for improvement than the surface.—*General Report*, vol. ii. p. 348.

† General Report of Scotland, vol. ii. p. 400.

‡ Kincardineshire Report, p. 398.

The celebrated Duke of Bridgewater effected a considerable improvement in this manner. He covered a part of Chat-moss, with the refuse of coal-pits, a mixture of earths and stones of different qualities and sizes, which were brought in barges out of the interior of a mountain; and, by compressing the surface, enabled it to bear pasturing stock. Its fertility was promoted by the vegetable mould of the morass, which presently rose, and mixed with the heavier materials which were spread upon it*.

The method of covering the surface of fen-land, with clay or marl, is strongly recommended in a paper on the Improvement of Huntingdonshire. It appears, that under the fens of that county, and not far from the surface, there is a species of clay marl, of a soft quality, that may be easily worked. Where that substance is mixed with the fen soil, the finer grasses flourish beyond what they do on the fen soil unmixed; and when the mixed soil is ploughed, and sown with any sort of grain, the calcareous earth, renders the crops less apt to fall down, the produce is greater, and the grain of better quality than on any other part of the land†. In some parts of Thorney Fen, (on the estate of the Duke of Bedford), the tenants have begun the practice of *claying* the light surface, by trenching with a spade.

Mr. Rodwell, in Suffolk, has distinguished himself by covering the surface of heath-land with clay and marl, to a very extraordinary extent. With only two leases for 28 years, he clayed and marled 820 acres, and used about 140,000 tumbril loads, which, at 8½*d.* per yard, cost him 4958*l.* Having taken a third lease, in the space of about 49 weeks, he employed 11,275 cubical yards of clay more in covering the soil. He prefers clay to marl on sandy soils, some of which consist of coarse, poor, and even black sand. The result was highly satisfactory: 350*l.* per annum were added to the value of the estate, which, at 30 years' purchase, is 10,500*l.*; and the public was benefited by the produce of more corn, meat, and wool, to the amount of 30,000*l.* in 28 years succeeding the improvement, than in the 28 preceding it‡.

In various districts, the soil is covered with chalk, at the rate of from sixty to one hundred loads per acre, and it is considered to be a profitable practice§.

* Marshall on Landed Property, p. 46.
† Huntingdonshire Report, p. 301.
‡ Communications to the Board of Agriculture, vol. ii. p. 451.
§ Ditto, p. 44.—In Young's Norfolk, Chapter VI. on Enclosures, various

In Scotland, this practice has been restricted to peat-bogs. In several instances, the whole surface has been covered with earth, clay, sand, gravel, shells, or sea-ooze, two or three inches thick, or more, (for the covering cannot well be over done), and land, originally of no value, has thus been rendered worth from 2*l.* to 3*l.* and even 4*l.* per acre. The horses upon this land, must either be equipped with wooden clogs, or the work performed in frosty weather, when the surface of the moss is hard. Coarse obdurate clay, (provincially *till*), is peculiarly calculated for this process, as, when it is blended with peat, and some calcareous matter, it contains all the properties of a fertile soil*. This is certainly an expensive method of improving land, unless the substance to be laid upon it, is within 500 yards distance: but where it can properly be done, the moss thus obtains solidity, and after it has been supplied with calcareous earth, it may be cultivated, like other soils, in a rotation of white and green crops. In the neighbourhood of populous towns, where the rent of land is high, the covering substance may be conveyed from a greater distance than 500 yards.

5. *Floating off the Surface of Peat-Bogs.*—This singular mode of improving waste lands, *is applicable only* where there is a command of water, and where the subjacent clay is of a most fertile quality, or consists of alluvial soil. A stream of water is brought into the moss, into which the spongy upper stratum is first thrown, and afterwards the heavier moss; the whole is then conveyed, by the stream, into the neighbouring river, and thence to the sea. The moss thus got rid of, in the most remarkable instance of floating, (that of Blair Drummond in Perthshire), was, on an average, about seven feet deep. Much ingenuity was displayed in constructing the machinery, to supply water for removing the moss, previous to the improvement of the rich soil below. It required both the genius and the perseverance of Lord Kames, to complete this scheme; but by this singular mode of improvement, about 1000 English acres have been already cleared, a population of above 900 inhabitants furnished with the means of subsistence, and an extensive district, where only snipes and moor-fowl were formerly maintained, is now converted, *as if by magic*, into

instances are given, of the success attending this mode of improvement. This dressing adds rather more than half an inch of calcareous earth to the soil.

* Clydesdale Report, p. 150, note.

a rich and fertile *carse**, or tract of alluvial soil, worth from 3*l.* to 4*l.* per acre†.

6. *Rolling.*—The improvement of peaty or moory soils, by rolling, in conjunction with the other operations above explained, is of the highest importance. The greatest defect of soft soils is, that the drought easily penetrates them, and they become too open. The roller is an antidote to that evil, and the expence is the only thing that ought to set bounds to the practice of this operation. It also tends to destroy those worms, grubs, and insects, with which light and fenny land is apt to be infested.

The roller for such soils, ought not to be heavy, nor of a narrow diameter. If it be weighty, and the diameter small, it sinks too much where the pressure falls, which causes the soft moss to rise before and behind the roller, and thus instead of consolidating, it rends the soil. A gentle pressure consolidates moss, but too much weight has a contrary effect. A roller for moss, ought therefore to be formed of wood, the cylinder about four feet diameter, and mounted, to be drawn by two or three men. If horses are employed, they ought to have clogs or pattens, if likely to sink‡. The oftener the rolling is performed, on spongy soils, (as long as the crops of corn or grass will admit of it), the better, and the more certain is the result.

After waste land has thus been reclaimed, it may of course be still further improved, by the usual processes, to be afterwards explained, under the several heads of *enclosing*, *draining*, *manuring*§, *irrigation*, &c. Where such land,

* Carse, it appears, is a Welsh word; but spelt *corse*. It implies in Wales, wet or fenny land. See the South Wales Report, vol. ii. p. 93 and 102.

† General Report of Scotland, vol. ii. p. 364. In the Appendix to that Report, vol. ii. p. 38, there is a particular account of this singular and important improvement, against which some prejudices are entertained, by those who have not seen the effects. The alluvial soil at the bottom, is found to be greatly preferable to the peat above it, a mixture of which, however, is considered to be useful.

‡ In the Communications to the Board of Agriculture, vol. ii. and in the second Report from the Select Committee of the House of Commons, on the state of disease and the condition of the Labouring Poor in Ireland, (printed in June 1819), there are engravings of these pattens, and a description of them.

§ It may be proper to mention here, the superior importance of lime, in cultivating waste lands. Mr. Simpson, near Pickering, in Yorkshire, in the course of improving some waste lands, left one acre of as good soil as any of the rest, unlimed. The first crop was turnips, in which it was not perceptible: but it was strikingly marked in the next crop, that of oats, and still more so in the grass-seeds, as very little clover was seen. The other

however, lies in a cold and exposed situation, or is so encumbered with rocks and stones, that clearing them would be attended with much expence, and where it would be of little value in pasture, the best mode of improvement is certainly *by planting*. Indeed both in Scotland, and in the Netherlands, it has been found, that planting waste lands, even in low situations, is the surest means of laying a foundation for their future fertility and cultivation; the surface being thus covered, and the soil enriched, by the annual accession of vegetable matter, from the decayed leaves*.

4. *Rules to be observed regarding the Improvement of Waste Lands.*

In the cultivation of wastes, the following rules may be laid down.

1. Not to put in practice any scheme of improvement, without the fullest deliberation, nor without the command of an adequate capital.

2. Not to begin on too great a scale, nor until, by experience it be found, that the design is suitable to the soil, situation, and climate†.

3. When the intention is to cultivate bogs, or peat mosses, not to begin cropping, till at least one season after the drains are completed, and the soil thoroughly reclaimed from superfluous moisture. In bogs abounding with fluid matter, (flow mosses), a longer time is necessary.

4. To plough or delve peat-moss in autumn, that it may first be effectually exposed to the winter frost and rains, and not to the summer's heat, which would harden it, and prevent its decomposition.

5. Whatever is done, to do it *effectually*‡; not to think of

part of the field became tolerably good herbage, with some small branches of ling or heath thinly scattered amongst it; *but that part of the field that was unlimed, was nearly destitute of herbage, and covered with heath.—North Riding Report*, p. 209; *Derbyshire Report*, vol. ii. p. 436.

* Statistical Account of Scotland, vol. vi. p. 530.—Parish of Forfar: also Hints as to the Agricultural State of the Netherlands, already alluded to. Part I. p. 72. The same idea occurred to Dr. Beeke, that by means of fir plantations, the staple from the decaying vegetable matter, might be so increased, that the most barren wastes might be rendered fit for corn.—*Berks Report*, p. 333. It has been remarked, that lands, covered with fir, by nature, are not of much value for cultivation; but they are in general of a barren rocky quality; and the improvement is only effected by *young* trees.

† See the Rev. Mr. Willis's valuable paper.—Communications to the Board of Agriculture, vol. vi. p. 17, and 23.

‡ It is upon this principle that the Flemish acted, who have improved such an extent of waste land.—They never brought more barren soil into

laying on four acres, the manure necessary for three; nor the lime, chalk, earth, clay, sand, or gravel, upon two acres, that should be employed in covering only one.

6. To carry on the improvement of waste lands, without encroaching upon the dung necessary for the improved part of a farm, as dung ought never to be brought from a good soil, to lay upon a bad one. Unless dung therefore can be procured from a neighbouring town or village, it will be better to leave the lands in their natural state, except in cases, where the soil, by being pared, burnt, limed, or marled, or covered with chalk, clay, earth, &c. will pay the expence of the improvement, and rendered so fertile, that it can afterwards be preserved, in a good condition, from its own resources.

7. The last rule is, to lay down any land, improved from waste, *in high and bleak situations*, as soon as possible into grass, and to retain it in that state as long as it is tolerably productive. For though grain and roots may be cultivated on waste lands, when properly improved, and favourably situated, yet grass pastured, particularly by sheep, is principally to be depended on for improving weak soils, in barren districts, and remunerating the improver.

5. *Of the Advantages to be derived from the Culture of Waste Lands.*

These are either of a private, or of a public nature.

1. *Private Advantages.*—It has been thought, that greater profit may be derived from the improvement of wastes, or of lands not hitherto completely cultivated, than of similar soils that have been long under the plough. The rent is necessarily lower, they are freer from weeds, and if once brought into good order, and properly managed afterwards, will give lucrative returns. Instances might be stated in support of the above doctrine, but unfortunately it has not in every case been sanctioned by experience. The real cause is, that a great expence must be incurred in the first instance, while the subsequent advantages are uncertain.

As it is impossible to go through the numerous examples of the profitable improvement of wastes, in such a condensed work as the present, it is proposed to state, two of the most important instances, that England and Scotland can respectively furnish.

into cultivation at a time, than they had *abundant* manure for.—*Communications to the Board of Agriculture*, vol. i. p. 225.

A variety of experiments in the culture of wastes, have been made on the estates of Charles Duncombe, Esq. of Duncombe Park, in Yorkshire, the principal particulars of which are detailed in his Communications to the Board of Agriculture*. The whole contains about 840 acres, and what renders these experiments peculiarly important, is, that a considerable proportion of the land, was improved in small lots, by several persons, and under different systems. The following results have been drawn from these experiments, 1. That by paring and burning, the matted substance of peat, and the roots of heath, were reduced to a substance that assists vegetation, and the land being thus sooner brought into cultivation than by any other process, that plan ought to be preferred†. 2. That in an elevated situation, and a bleak climate, rye ought to be the first crop. 3. That potatoes is the most productive crop, provided long dung could be spared. 4. That lime materially assists in decomposing vegetable substances, and ameliorating the soil; and, 5. That when such lands are laid down with artificial grass-seeds, it is most advisable to keep them in pasturage, and to refrain from cutting them with the scythe.

The exertions made for the improvement of Chat-moss, in the county of Lancaster, do credit to the zeal and ability of the ingenious Mr. Roscoe. This tract contains about 2500 acres, entirely composed of peat, from ten to thirty feet deep. The drainage was begun in November, 1805, but it was not till the year 1809, that any crops were raised, and these were restricted to about 20 acres of oats and turnips. In the succeeding year, 80 acres were cropped, of which 20 were wheat; and it soon appeared that, under a judicious system, abundant crops of wheat, beans, oats, potatoes, and clover, might be expected‡.

Mr. Roscoe has given a statement of the expence of improving and cropping an acre of Chat-moss, in 1812, with its produce. The expences, including 20 tons of Manchester manure, for which, and its conveyance, 5*l.* is charged, amounts in all to 20*l.* 7*s.* per acre. He states, that the

* See vol. vii. Part I. p. 127; and Part II. p. 244.—Three premiums of gold medals were voted by the Board for these exertions.

† In a valuable account of the improvement of a tract of waste land, by Mr. Simpson, upon the Pickering Moors, in Yorkshire, he observes, "That the great error into which many have fallen, is the ploughing out the tough mossy swards without paring and burning, which occasions an almost total failure of crop, and of course a want of manure for the next succession. —*North Riding Report*, p. 223; *Derbyshire Report*, vol. ii. p. 404.

‡ Carrots might likewise have been tried.

crops, with the value of the straw, repaid the full expence the first year, the price of grain being high; but even at more moderate rates, there can be no doubt, that the money expended in the improvement, may be speedily returned.

Mr. Roscoe considers calcareous manure as essential to the improvement of peat-moss. As the quantity of lime necessary for that purpose is so small, in proportion to that of marl, where the distance is great, and the carriage high, it is more advisable to make use of that substance; but where marl is upon the spot, and can be obtained in sufficient quantities, at a reasonable expence, the use of it appears to be preferable.

The result of Mr. Roscoe's experiments is, that all temporizing expedients are fallacious; and that there is no effectual method of improving peat-bogs, or moss land, *but by the application of calcareous substances, in sufficient quantities to convert the moss into a soil, and by the occasional use of animal or other extraneous manures, such as the course of cultivation, and the nature of the crops, may be found to require**.

In Scotland, Mr. Smith of Swinbridge-moor, near Beith, in Ayrshire, and Mr. Maclean of Mark, in Galloway, are two of the most distinguished improvers of waste lands.

Mr. Smith began, about the year 1783, to reclaim some of the peat-mosses on his estate, and was perhaps the first who recommended the application of lime alone to mossy soils, and proved its efficacy. After cutting proper drains in autumn, he formed the peat into ridges of seven or eight yards in breadth, but of a moderate height, by the spade. As soon after this operation as possible, the ridges were manured with lime, (the more caustic the better), at the rate of from 100 to 200 Winchester bushels of lime-shells per English acre, and the next spring sown with oats. Potatoes usually are a better and more profitable crop, but they require dung. The annual clear profit, for the first five years, is said to be, on an average, at the rate of 2*l.* 10*s.* per English acre, and the land thus improved, from a waste of no value, lets at 1*l.* per English acre. This system is considered so advantageous, that it has already been extended to Russia and Sweden†.

Mr. Maclean has improved no less a quantity than 687

* Communications to the Board of Agriculture, vol. vii. p. 438.

† General Report of Scotland, vol. ii. p. 367. Mr. Monteath of Closeburn, has proved its efficacy, and has great merit for his extensive improvement of waste lands.

English acres of waste land. He conducts this business with such ability, joined to economy, that he never reclaimed an acre, which has not made him a large return for the capital expended. The land he has improved, is above 400 feet above the level of the sea, and the soils greatly diversified. His example is a great encouragement to all proprietors of waste lands, to set about improving them without delay, as, in that way, their interest would be better promoted, than by any other plan that could be suggested. It is sometimes by paring and burning, and at other times by covering the surface, according to the nature of the soil, and other circumstances, that his improvements were carried on*.

Among the various modes of improving wastes, that of bringing them into a state of cultivation, by establishing colonies of labourers, fishermen, tradesmen, &c. in advantageous situations, has been found beneficial to the proprietor and to the public. To the first, because his land is improved, perhaps without any expence being incurred by him; and to the second, because, as a distinguished character has well observed, when land is given to a cottager for a number of years, under a small reserved rent, he and his family will exert in its cultivation, a quantity of labour, *which would not otherwise be called into action;* and by which, many thousand acres of land may be cultivated, which would not, in any other mode, pay the expence of improvement†.

2. *Public Advantages.*—Whether exertions for the improvement of wastes, are beneficial or injurious to the undertaker, there can be no doubt, that they are advantageous to the public. By these means, thousands of acres have been already added to the national stock of arable land, which, in proportion to their extent, will continue to yield food for our increased population. Besides the multitudes employed in reclaiming these wastes, occupation is provided for as many persons as are requisite for their subsequent cultivation; and the surplus food, beyond what the actual cultivators may require, increases the fund of provisions for maintaining those who are employed in manufactures and commerce. In all these respects, the improvement of waste and unproductive land, is an object of very high national

* They are described in the Galloway Report.

† Preliminary Observations to the Westmoreland Report, by the late Dr. Watson, Bishop of Landaff, p. 8. General Report of Scotland, vol. ii. p. 388.

importance, and well deserves the attention, and indeed *the encouragement* of the legislature*.

Sect. II.—*On the Nature and Advantages of Enclosures.*

The benefit to be derived, from dividing lands under cultivation, into regular fields, has been already explained. (See Chapter II. Sect. 10). It is here proposed to consider,—The advantages and disadvantages of having these fields *enclosed* and *fenced;*—The sorts of enclosures best calculated for different soils and situations;—The principal fences to be recommended;—The effect of hedge-rows; and,—Some miscellaneous particulars connected with the subject of enclosure.

1. *Advantages and Disadvantages of Enclosures.*

Enclosures and fences, when judiciously designed, and properly executed, are attended with the following advantages:

1. The mere enclosure of wastes, lays the foundation of their future fertility. By the shelter thus obtained, and by the plants being protected from poaching, the natural grasses are enabled to make more progress, than if the field had been left open and exposed; and by the dung of the sheep or cattle pastured thereon, the ground is gradually enriched, and ultimately rendered fit for cropping, when cultivation is afterwards resorted to†.

2. Where lands are wet, the ditches employed in fencing them, both render the enclosure dry, and may supply it with running water, in situations where that article is required.

3. In cold climates, and more especially in bleak situations, the effects of enclosure, in sheltering the land, and rendering it more productive, are hardly credible to those who have not experienced them‡. In a mountainous district where that plan was adopted, the climate was rendered

* Mid-Lothian Report, Appendix, No. XI. p. 104.—Middlesex Report, p. 107; where the advantages of improving wastes, *in the neighbourhood of the metropolis*, are fully explained.

† Caithness Report, Appendix, p. 141. Holt's Lancashire, p. 103.

‡ Aberdeenshire Report, p. 221. In dry soils and in warm climates the shelter of lofty trees is of use, to protect the crops from the violence of the sun, and the evaporation it would otherwise occasion. This is found in the Netherlands, particularly in the Pays de Waes, and the same system might be useful in some parts of England.

milder, the soil more productive, the tenantry became more comfortable in their circumstances, and, some so affluent, that they could purchase the fee-simple of their farms*.

4. In pasturage, the advantages of enclosures are of the highest importance. The farmer is, in a great degree, relieved, from the heavy expence of attending his stock; and he has it in his power to arrange them, according to their age, condition, and other circumstances.—The pasturing stock are not only protected, from being perpetually harassed and interrupted in their feeding by dogs, or other intruders, but, in general, have access to water when they please, and by these means, improve much faster, than on the same extent of unenclosed land.—The grass, owing to greater warmth and shelter, is earlier and more abundant, where protected by the fences, than in bleak exposed open lands of similar soils, and in the same neighbourhood.—The live-stock, in the summer season, suffer less from heat, are protected in cold and stormy weather†, and in particular, have sheltered places to resort to, where they may sleep or ruminate.—The stock likewise, being more quiet, do not poach the ground so much in wet weather‡. From these advantages, joined to that important one, of being enabled to shift from one field to another, for fresh supplies of grass, experienced graziers entertain the highest opinion of their utility§.

5. In the management of arable land, many solid advantages are derived from enclosures. When the land is open, it is exposed to trespass; but when enclosed, the farmer is secured against encroachment,—can adopt a correct and profitable rotation of crops,—can proceed with vigour in its cultivation,—and can reap its fruits with safety:—an increased produce is the necessary consequence of these advantages. Where corn, however, is the principal object, the enclosures ought to be large.

6. In some districts in England, coals are dear, or fuel scarce, and mixed hedges, from the quantity of wood they produce, are considered to be profitable. The fence, however, in that case, is not so good, and more ground than usual must be allotted for the purpose.

* Perthshire Report, p. 118.

† Dr. Skene Keith observes, that the difference between enclosures, and the bleak unsheltered lands in the same neighbourhood, is often from five to eight degrees of the thermometer.

‡ General Report of Scotland, vol. ii. p. 276.

§ Middlesex Report, p. 137.

7. The oak-timber that grows in hedge-rows, is more valuable than any other for naval purposes, furnishing that *knee-timber*, so essential in the construction of ships of war.

8. The very appearance of enclosure indicates comfort and security. Landlords, on that account, never fail to draw very advanced rents from well-enclosed lands. They generally let at from 2*s*. to perhaps 10*s*. or 15*s*. per acre higher, than open lands, of the same description, in their immediate neighbourhood. Besides this additional rent, the farmer, from a consciousness of the benefit derived from them, will often undertake to uphold the fences, at his own charge, during the lease.

9. Enclosure also, by means of ditches, contributes both to drain, and to improve the climate of a country; while the neighbourhood of open fields and commons, tend to render the rigours of the climate more severe*.

In regard to "*The disadvantages of enclosures*," they need not be dwelt on, as they can only be said to exist in the abuse or mismanagement of the system. Enclosures too small, especially on low fertile ground, harbour insects, and produce too much shade; these contribute to deteriorate the quality of the produce; and cattle and sheep are more exposed to torment and danger from different species of flies.

Another species of disadvantage arises from the *ill shape* of enclosures, and their not being laid out according to aspect or slope: these errors have been so glaring and inconvenient, that in some instances, old enclosures have been entirely new-divided, and the old fences grubbed up.

It has also been remarked, that enclosures are attended with this disadvantage, that they retain moisture among the trees and hedges, and prevent the full effect of wind in drying the crop during harvest. But this inconvenience, is in some degree compensated, by the corn becoming earlier ripe, from the warmth which the enclosures furnish.

Some have imagined, that the soil might be injured, by the greater evaporation which the warmth of enclosures may occasion. But it can hardly be disputed, that evaporation is more promoted, by free air and wind, than by heat.

On the whole, it appears, that the arguments in favour of enclosures, as a general system, greatly preponderate:

* Middlesex Report, p. 108.

nor is it an unimportant consideration, that they give a country a more ornamental and picturesque appearance.

2. *The Sorts of Enclosures adapted for different Soils and Situations.*

The nature and size of enclosures, ought to vary according to situation and other circumstances, the principles of which shall be briefly explained.

1. *Enclosures in the vicinity of Towns.*—Near a town, small enclosures are usually preferred. From five to ten acres, may, in general, be considered as the most convenient size. As wooden fences and dead hedges are liable to depredations, the most advisable fences for such enclosures are, either quick-hedges dressed thick and low, or stone walls, edged or tipt with lime†.

2. *Enclosures in low and rich Soils.*—Where the soil is retentive of moisture, open drains or ditches are used, for the double purpose, of dividing the fields, and clearing them from superfluous water; but unless the stock are accustomed to such a fence, they are apt to fall into the ditches, by which some are maimed, and occasionally destroyed; and if posts and rails are erected to prevent such accidents, they seldom last long‡. If smaller drains are wanted, they ought to be covered, that all the valuable soil that can possibly be obtained, may be turned to profitable use. Where it would be an imprudent waste, to occupy valuable land in fences, stone walls are to be preferred; or a fence of white-thorn may be raised. But that will require the protection of a railing of wood, or a low stone wall, on the one side, and a ditch on the other. After the hedge has grown to a proper size, the temporary wall may be removed, the ditch filled up, and from that time, the hedge itself, except where an open drain is necessary, is the only remaining incumbrance upon the land.

3. *Enclosures in Low Arable Farms.*—In such situations, where circumstances permit, the fields should be from fifteen to twenty-five to thirty acres; and the fences either stone walls, or hedges trained close and low. Some smaller enclosures, near the dwelling-house, are of use, according to the size of the farm, for various purposes, in particular,

* Middlesex Report, p. 108.

† Derbyshire Report, vol. ii. p. 259, 279; and vol. iii. p. 269.

‡ Husbandry of Scotland, vol. i. p. 45.

for the rearing of calves, or young horses, where they may be attended to, and watched with greater convenience.

4. *Enclosures in Upland Farms.*—The soil of upland farms is generally cold, and of inferior quality. To secure early and rich grass, and to shelter the live stock, the enclosures ought to be considerably smaller than in lower farms; belts of several sorts of wood should be raised, or hedges of beech or holly, which, though of slow growth, will certainly thrive in dry and gravelly soils, where the thorn would fail. In Devonshire and Cornwall it is usual, to make copse fences on large mounds of earth, which, in time, pay for the expence of making them, by the fuel they afford, and the shelter they furnish, both to the land and the cattle.

5. *Enclosures on Mountain Sheep-Farms.*—No sheep-farmer can carry on his business with satisfaction and profit, without some enclosures. There ought to be at least *a tup-park*, or enclosure for the rams; *an hospital park*, for such diseased or unfortunate sheep, as require better food, or more shelter, than the rest of the flock; an enclosure for water-meadow, or early grass; and some enclosed ground for cultivation. Without such aids, the sheep-farmer can never expect to escape the baneful effects of fatal distempers;—nor can he improve the breed and character of his flock;—nor maintain his sheep during severe weather, when they are unable to dig through the frozen snow for subsistence;—nor protect them from general destruction, during snow-drifts, if the farm be entirely open. For these obvious reasons, every sheep-farm ought, if possible, to be accommodated with several enclosures, well fenced with strong walls, and constructed in the most effectual and approved manner.

6. *Enclosures on New Farms.*—The plan of enclosure to be adopted on new farms, depends upon circumstances. If a considerable extent of arable land must be separated from mountain pasture, a ring-fence, consisting of a strong wall, with a rough stone coping, placed edgewise, (the Galloway dyke), ought to be constructed for that purpose, within which is to be comprehended, the arable land, the meadow, and the cow-pasture; and contiguous to this general fence, plantations ought to be made for shelter and ornament.—If the whole farm, though bleakly situated, is capable of cultivation, belts of planting ought to be formed on the more exposed parts, and hedges raised as subdivi-

sions. Besides the hedge-rows, or belts of planting, the corners of the fields, which are not accessible to the plough, may likewise be planted. It is proper to give a bend to the clump, that the plough may be turned more easily: and, adjoining to this clump of wood, a single pond, properly placed, may accommodate several fields*.

3. *The Nature of the Fences.*

There is a great variety of fences, calculated for different purposes, but the most generally used, are, 1. Stone walls; and, 2. Hedges of thorn, and other plants†.

1. *Stone Walls.*—This species of fence has one advantage, that, according to a common saying, "*it is major from its birth,*" or, in other words, attains its greatest perfection as soon as made. Stone walls, however, have this disadvantage, that they are gradually getting worse; and, according as they are well or ill executed, unless built with lime, require, at the rate of from one to two per cent. per annum, to keep them in repair‡. The propriety of erecting a fence of this kind, depends much upon the nature and quality of the soil to be enclosed;—the quantity and fitness of the loose stones to be met with in the soil;—the vicinity of the quarry where the stones are dug;—and the advantage of obtaining lime at a moderate expence, by which the construction of the wall can be much improved, and rendered more durable. Where all these favourable circumstances are combined, stone walls, though not so ornamental as hedges, are preferable in point of utility; the benefit of the enclosure being immediate. They also occasion the least waste of ground;—do no injury to corn crops;—do not harbour vermin, if well built or edged with lime;—and are free from the weeds and rubbish that almost invariably accompany live hedges§.

The expence of erecting stone walls is considerable. Where they are built with lime, and five feet three inches in heighth, the expence of enclosing a field of moderate size, cannot be estimated at less than ten pounds per acre,

* Husbandry of Scotland, vol. i. p. 48. Derbyshire Report, vol, ii. p. 84.

† In the Communications to the Board of Agriculture, vol. ii. p. 1, there is a very interesting Paper on Enclosures, by the late Robert Somerville, Esq., with engravings of no less a number than sixty-four modes of enclosure, some of them quite simple, and others more complex.

‡ Kames's Gentleman Farmer, p. 269.

§ Middlesex Report, p. 135. Stone fences generally indicate a thin light soil, and, on such land, quickset hedges could hardly be raised as a fence.

even in cases where the lines of division are neither crooked nor irregular*.

Where lime is not used, "*the Galloway dyke,*" is preferred to every other species of dry stone wall. It is built *double;* that is to say, the two sides are formed of two different sets of stone, resting against each other, and connected by larger stones, which, from time to time, are laid across the wall. The whole, according to the more recent improvements, is completed, by putting upon the top of the dyke, as close as they can be laid together, stones placed edgewise; and when a considerable extent has been thus laid, thin stones are driven in like wedges, at small intervals, which bind the whole so firmly together, that, when well built, a stone can hardly be taken out of the top, without an iron crow†. Long experience has fully proved, that animals are more deterred from attempting to get over this rugged coping, than a more solid wall, even of a greater height, without that peculiarity in its construction.

Through the whole range of the Cotswold hills of Gloucestershire, (from Bath to Stow on the Wold), and now fast extending, (in practice), into the adjacent vales; owing to the uncontrolable disposition of the poor to destroy every combustible article in fences, stone walls, about five feet high, is the mode of enclosing.

The stone is of the white sort, and commonly lies near the surface, in flat beds or strata. This stone perishes by the action of frost, on any *wet,* being *confined* in it. The use of lime or other mortar, is *therefore necessarily rejected;* and the prudence or propriety of erecting this fence, in *no sort* depends on vicinity to lime. If the flat bedded stone be carefully selected, and well put together, by masons accustomed to this work, the walls last an indefinite time, and are repaired at a very easy expence. The original cost of a five foot wall of this kind, where, (as is generally the case), the stone lies near at hand, is not more than from 4*s.* 6*d.* to 6*s.* the perch (statute measure).

It is not possible to say, what is the cost per acre, of enclosing land in this manner, without *defining the extent* and *shape* of the space enclosed. Suppose, (for instance),

* Brown's Treatise on Rural Affairs, vol. ii. p. 297.

† Husbandry of Scotland, vol. i. p. 447.—Where the wall is not built too open below, it is of great advantage, to introduce a little lime between each stone, along with the wedges or pins.—*General Report of Scotland,* vol. i. p. 307.

a field of ten acres, enclosed in a square, the cost would be about 4*l.* per acre. If in an extended parallelogram of 80 by 20, the expence per acre would be raised to 5*l.*; and for that sum, where the stone is within a moderate distance, any field may be enclosed, whose shape does not *greatly* deviate from *the square**.

2. *Hedges of Thorn.*—The hawthorn, *(cratægus oxycantha*, Linn.) or white thorn, is justly accounted preferable for a fence, to every other plant, hitherto known in Europe†. If placed in a proper soil, it is a quick grower, is of a hardy nature, produces numerous branches, has prickles for its defence, becomes stronger by age, and when properly trained and occasionally cut over, there is no period to its duration. If suffered to grow too tall, it makes but a bad fence, becoming open below, and from its height, injurious to the crops in its neighbourhood. When hedges, therefore, come to a proper height and strength as fences, they ought to be cut into a shape, the least likely to give obstruction to the motion of the air, or to do injury either to the roads, or the fields in their neighbourhood‡.

If hedge plants of five years old can be procured, Lord Kames maintains, that they deserve all the additional sum that can be demanded for them, as they require less railing for their protection§. Hence the establishment of nurseries, for raising hedge-plants to a stature fit, or nearly fit, to form a fence, with less necessity for their being guarded, has been strongly recommended. Such plants would be of particular use in filling up gaps and unnecessary gateways‖.

Instead of posts and rails, which are apt to be destroyed,

* Communications from Sir George O. Paul, Bart.

† There is reason to believe that very useful plants might be obtained from America, for the purposes of enclosure.—The cockspur, or Newcastle thorn, produced and cultivated in the Delaware State, has a thorn, or pike, strong and sharp, from one and a half to three inches in length. The Virginia thorn, which makes an excellent fence, is a still more rapid, and uniform grower, with an abundant armour of prickles, about an inch long, and remarkably sharp.—*American Farmer, June* 25, 1819. It would be extremely desirable, to have these plants tried, and compared with the European white thorn.

‡ Kames's Gentleman Farmer, p. 272.—Husbandry of Scotland, vol. i. p. 47. Derbyshire Report, vol. iii. p. 270.

§ Gentleman Farmer, p. 274.

‖ Herefordshire Report, p. 50.—Marshall's Review of the Western Department, p. 322. Others think, that the old sets should be used only for filling up gaps, and for this purpose to be planted with good roots, and with careful digging below. They should also be left a foot and a half taller than the adjoining *stools* of the hedge, because they do not shoot so early.

some have tried low walls of stones, to protect the young hedge*; and others a mode of planting the hedge, protected by a mound between two ditches, the whole occupying the space of about fourteen feet. By the time the hedge becomes a fence, the ditches are completely filled up by the earth of the mound, so that no ground is lost†.

If a farm is enclosed by hedges, and cultivated under the alternate husbandry of tillage and pasturage, it is an excellent rule, when the fields are broken up, to cut down the hedges; and thus every objection to the injury sustained from such enclosures, to crops of grain, is obviated. The mode of cutting them down must vary according to circumstances: if the hedge is thin, let it be cut down about six inches from the ground; but if sufficiently thick, from three to four feet. In the former case, all gaps ought to be carefully filled up by planting; but they may be filled up, not only by inserting new plants, but by laying down branches of the old ones in the gap, as those may be made to take root‡.

The following rules are recommended to the planters of thorn hedges:

1. With a view to utility, it is better to make the whole hedge of one sort of plants, than to have a motley mixture of various shrubs;—unfit for being used as a fence;—producing weak and sickly plants;—injuring each other's growth;—shedding their leaves at different seasons of the year;—and presenting a discordant and offensive appearance§.

2. Thorns should be planted *in the natural soil*, if it is of a good quality. Their roots thus receive abundant nourishment, and spread, unchecked, with as much freedom as if they grew in a natural state‖. But when the line of a fence passes through soils of different qualities, it is proper, either to select such species of plants as are suitable for the respective soil, or by drainage, cultivation, and manuring, to

* The Galloway form, two feet high, with a coping, or a rugged row of stones above the wall, would answer the purpose of protection sufficiently.

† Stirlingshire Report, p. 123. This plan was adopted by a Gentleman in Scotland, the late Mr. Forbes, of Callander, who planted six millions of thorns, and whose line of fences measured about four hundred miles in length.

‡ Husbandry of Scotland, vol. i. p. 51. A long branch or stem must be half cut through, near the ground, fixed firmly in the surface by notched stakes, and covered with earth. The extreme end strikes root.

§ Communications to the Board of Agriculture, vol. ii. p. 14.

‖ Marshall's Review of the Northern Department, p. 41.

equalize them as much as possible, all along the line of the intended fence*. In poor soils, it is advisable to sprinkle a little rotten dung at the roots of the plants.

3. The young thorns should be planted with as much expedition as possible, after they are taken from the nursery; —they should not be placed deeper in the ground than what they had previously stood in the seed-bed;—they should be laid upon a gentle slope, or inclined plane, pointing downwards, so as to favour the transmission of moisture to the roots;—and they should not be cut, until they have been planted in the ground, when it can be done with more regularity;—the age of the plants, (whether of one or two years), is not so material, as that they should be healthy and well grown†.

4. The cutting of hedge plants is an important operation. They should always be *cut upwards*, and the best shape for them to be formed into, as that of a step roof, or the *hogged mane* of a horse; that is, narrow at the top, and wide at the bottom. Every twig thus receives its full share of rain, sun, and air, and the lower branches, are not injured and destroyed, by the dropping of water from those above‡.

5. Besides preparing the ground for the young plants, by a crop of potatoes or turnips, or by a fallow, and enriching it, if the soil is poor, by dung or compost, it is necessary, to have the hedge regularly cleaned once, and when young, twice in a season, that the young plants may be kept perfectly free from weeds§.

6. But the most important rule is, to plant the quicks, at from nine to twelve inches apart from each other, according to the fertility of the soils‖, and some recommend even a greater distance; but at twelve inches, they make more wood, and sooner become a strong and lasting fence. The closer they are planted, the more difficult they must find it to procure nourishment, and the greater number must die. It is well known, that when a quick-hedge comes to be from twenty to thirty years old, few of the thorns are nearer each other than from twelve to eighteen inches¶.

As hedges rarely thrive, after the roots of the thorns

* General Report of Scotland, vol. i. p. 312.

† See Blaikie's Tract on the Management of Hedges, p. 6.

‡ General Report of Scotland, vol. i. p. 314. Blaikie on Hedges, p. 33, and 46.

§ Brown on Rural Affairs, vol. ii. p. 299.

‖ Quicks have been found to answer well in middling soils, at nine inches asunder.

¶ Husbandry of Scotland, vol. i. p. 50, Note.

reach the close impervious bottom on which clays are incumbent, it has been found an useful practice, to cast a deep drain where the hedge is to be planted, and to fill it with stones, covered with good earth. The thorns will thrive as well by this method, as upon soils of a different description*.

Thorns may be raised from the roots cut off, when the plants are to be set in a hedge, as well as from seed. They must be put into a bed of fresh earth, and thus a perpetual succession of vigorous plants may be obtained†.

In making hedges, the plants should be assorted, and all those of the same size put together; where they cannot be had of uniform strength, the most healthy should be put in the poorest soil, and the weakly in the rich ones‡.

In many cases, from circumstances connected with the situation or soil, other shrubs are used for hedges than the white thorn; though none, on the whole, is comparable to it on suitable soils, or, when properly trained, forms so strong and durable a fence.

The common furze, gorse, or whin, *(ulex europæus)* will grow on poor soils in exposed situations§; but is attended with this disadvantage, that by the bursting of the pods, the seeds are scattered to some distance, and in clearing out the ditches, they are carried over all the fields, and are extirpated with great difficulty. The beech, therefore, is to be preferred, where it will grow, more especially from the shelter it affords, as the old leaves remain till the new ones sprout out; thus giving warmth to the adjoining fields, and to the stock pasturing in them, even in the midst of winter. The larch also has been tried with some success; though, it is obvious, that a fence of this sort, cannot answer for sheep.

The holly (*ilex aquifolium*), is of slow growth, but forms a close and beautiful ever-green fence. It ought to be transplanted from the seed-bed, the first year, either in May or June, which would, in general, ensure its thriving.

The horn-beam has been strongly recommended, and seems to merit more attention than has hitherto been paid to it in this country. It is not delicate in point of soil, but

* Brown's Rural Affairs, vol. ii. p. 300.

When thorns are planted in barren soils, it is found of use to dip their roots in common oil, before they are put into the ground.

† Kames's Gentleman Farmer, p. 273.

‡ Communications to the Board of Agriculture, vol. ii. p. 42.

§ See Essay on Whin Hedges, by John Gordon, Esq. of Swiney.—Transactions of the Highland Society of Scotland, vol. iv. p. 341.

will thrive on ground seemingly barren. It is likewise a quick grower, and becomes a fence peculiarly solid and permanent*. Its wood also, is preferable to yew, or crab, for mill cogs, &c. It may be transplanted at a good size;—and should be placed in such a manner, that the two plants may intersect each other, in the form of a St. Andrew's cross; which soon becomes a sort of living palisado, or *chevaux de frise*. It is not uncommon in Germany, to see the sides of the high-roads thus guarded for ten miles together†.

In the hedges of England, a great variety of trees are planted, as the hazel, the oak, the ash, the maple, the crab, the willow, &c. These furnish materials for manufacturing various articles,—supply the hop-planter with poles,—or may be used as fuel. Sometimes plums, gooseberries, and other plants, yielding useful and agreeable fruits, are to be met with‡; but this is a dangerous experiment, alluring idle boys to do much mischief to the hedges;—and sometimes the sweet-briar, and all the varieties of the wild rose are planted, for their smell or beauty.

4. *Hedge-rows.*

The planting of trees in the line of a hedge is, generally speaking, not to be approved of. Thorns do not thrive so well near the roots, nor under the drop of a tree. The roots also running into the field in all directions, often break and damage the plough, and interrupt the field operations. The corn growing under the shade and drop of trees, is almost universally laid down, of course not filled, unequally ripened, and not so soon ready for the stack-yard, as in the other parts of the field. In late and wet seasons, indeed, the corn is seldom harvested in proper condition, and in some instances it is totally lost. The ash, in particular, is a formidable enemy to corn. The influence of its roots, in attracting moisture and fertility, may be seen in a circular form, on every arable spot in their immediate neighbourhood. In fact, they are said to be *the landlord's thieves*, as they steal from the tenant's crop every year, ten times the value of their own increased value. The grass under their

* From the stiffness of its branches, it may grow well near the sea.

† See Harte's Essays on Husbandry, p. 114; also Weston's Tracts on Practical Agriculture, second edition, p. 131, and opposite to p. 38, are plans of what he calls the Palisade Horn-beam hedge.

‡ See a plan for that purpose in the Staffordshire Report, p. 43.

shade or drop, is likewise of inferior quality, compared to the other parts of the field, and is unwholesome to stock*. In flat countries, therefore, it is better to plant the corners of such fields as are not accessible to the plough, and where a great deal of useful timber may be raised. In hilly countries, on the other hand, belts of planting are advisable, from the warmth and shelter they afford.

There are some trees, however, which, comparatively speaking, do much less injury than others. The narrow leaved elm, and the black poplar, are of that description, and above all, the oak, which, in hedge-rows, produces timber, peculiarly well calculated for naval purposes. The planting of the oak, therefore, under a judicious system, ought not to be discouraged, for the growth and prosperity of such timber, is of great *national* as well as private importance†.

Fruit-trees in hedge-rows promise a profit, which is never realized; the fruit being generally stolen, and the trees mutilated‡.

5. *Miscellaneous Particulars.*

These principally relate to, Gates; Stiles; and Wickets.

1. *Gates.*—This is a subject of considerable importance, and includes the following particulars: Their position;—The substances on which they are placed;—Their dimensions;—Their form;—and, The materials used in making them.

1. Their position must be determined, by considering the roads and other communications with which they are connected, the size and form of the enclosures to which they lead, and the purposes to which these are intended to be applied.

2. Gates are fixed in various ways.—Sometimes on posts of oak or larch, being more durable than foreign fir. Sometimes living trees of considerable size, are transplanted with their roots, for gate-posts, a practice not to be recommended. Sometimes blocks made from a single stone, of a good quality, and a sufficient size, may be had, and are

* Mr. Middleton states, that these objections to timber-trees in hedge-rows, might be in a great measure obviated, by keeping them closely pruned below the height of fifteen feet.

† See Blaikie's Tract on the Management of Hedges, &c. p. 8, where there are a number of useful hints on the management of hedge-rows.

‡ Observation by Mr. Middleton.

greatly preferable to timber*; and sometimes round or square pillars, are built of stone and lime, with large stones inserted at that part of the pillar on which the gate hangs, to which the gates are appended†.

3. No field-gate intended for carriages, ought to be less than nine feet wide; and if the resort is frequent, ten feet is preferable. The height about five feet, or nearly the same as fences are usually made.

4. With respect to their construction, there is room for selection out of the various forms now in use. For interior enclosures, a cheap and simple plan is adopted, that of having a pillar at each side, into which four or more moveable bars may be made to slip in, or out at pleasure. That plan, however, will not do for passages much resorted to. The swing-gate, which turns on hinges at one side, and fastens by a latch at the other, which may occasionally be shut by a padlock and chain, is the most common in fences. For all places of considerable resort, this gate should be hung, so as to open easily, to the traveller, even on horseback, and to shut of itself. The folding gate, consisting of two parts, is best adapted to wide spaces, where one gate, occupying the whole, would be too large and heavy.

The importance of having gates that will shut and open readily, is known to every skilful farmer. When a gate is left open, flocks prone to ramble are sure to find it; they will probably do much damage to the adjoining fields of turnips, corn, or grass; they will become unsettled, and dissatisfied with their pasture, for many days, and even weeks; and thus the farmer, is not only injured in his crop, but in his stock‡.

5. The best materials for field-gates are, split oak§, or sound red Riga, Memel, or larch fir; materials not very heavy, and which will endure for some time. If oak be not procurable, the gates ought to be made entirely of these kinds of fir, or of pitch pine. In some parts of Scotland, and at Birmingham, gates of cast-iron are manufactured. They can be made as light as those of wood, and where

* Derbyshire Report, vol. ii. p. 92.

† Husbandry of Scotland, vol. i. p. 51.

‡ Remark by Isaac Leatham, Esq. in his Survey of the East Riding, p. 27. There is the plan of a new gate in the Farmer's Magazine for May, 1820, well adapted to straw-yards, if not for fields.

§ Mr. Fane of Oxfordshire, finds the *split oak* superior to any other, in point of duration, and not expensive.

iron is cheap, nearly at as low a price*. In Cheshire, gates are sometimes made of bar iron, of the ordinary size, at an expence of from two to three pounds†. Great care ought to be taken, to guard gates and pillars by large stones, and to make the roads in passing them, smooth and hard.

But notwithstanding every precaution, gates are a perpetual source of expence and vexation to the farmer. It has therefore been suggested, as a useful plan, to contract with a carpenter, to keep them in repair at a certain sum per annum. This would induce him to examine every gate frequently, and thus to preserve them in good order‡. For their better security, a respectable magistrate, (Sir John Thomas Stanley), has suggested the propriety of an express law, to punish offenders, who wantonly injure so material a means of protection to agricultural property§. At present, in some places, the stealing of gate hooks and iron fastenings, is so common, as to compel the farmer both to hang and to fasten his gates with wood; which is cheaper, though not so secure, nor so lasting as iron‖.

2. *Stiles and Wickets.*—These are necessary in enclosures, for the admission of foot passengers, while horses and cattle are thus excluded. They should be simple in their form, and made of durable materials.

On the whole, a well-enclosed farm, is a strong inducement to any occupier, to exert his utmost energies, in carrying on every species of improvement that can be advantageously undertaken; while by enclosures, the appearance of the country is improved, its climate ameliorated, and its value materially augmented.

Sect. III.—*On Draining.*

Relieving land from superfluous moisture, is one of the most important branches of husbandry, Unless that be accomplished, every other improvement of which the soil is susceptible, must often be unsuccessfully attempted. Fortunately, no department in agriculture, has been of late more anxiously studied, nor with greater practical success. The basis was laid by the discoveries of a farmer in War-

* General Report of Scotland, vol. i. p. 299, and 328.
† Cheshire Report, p. 122.
‡ Shropshire Report, p. 150.
§ Cheshire Report, p. 122.
‖ Middlesex Report, p. 137.

wickshire, (Joseph Elkington), who was led to it by an accident . It is a happy event for society, when such accidents occur to those, who have sense sufficient to avail themselves, of hints thus fortuitously suggested.

In discussing this subject, the following particulars shall be considered: 1. The advantages of draining; 2. The causes of wetness; 3. The sorts of drains commonly used; 4. The instruments employed; and, 5. The modes of draining the different soils, and the objects to which that improvement is applicable.

1. *Advantages of Draining.*

The benefit of draining is experienced, 1. In arable land; 2. In grass land; 3. In woods and plantations; 4. In the improvement of wastes; 5. In the climate; and, 6. In various miscellaneous particulars.

1. *Arable Land.*—While land remains in a wet state, the manure laid upon it, whether putrescent or calcareous†, is, comparatively speaking, of little use;—the seed sown often perishes‡;—the crops are sickly, and later of ripen-

* In the year 1764, Elkington began to drain some fields on his farm of Princethorpe, which were so extremely wet, that it occasioned the rotting several hundreds of his sheep. He had dug a trench for that purpose about four or five feet deep, which did not however reach the *principal body of subjacent water*, from which the evil arose. *By accident*, while he was deliberating what was to be done, a servant was passing with an iron crow, or bar, for fixing sheep-hurdles in an adjoining part of the farm. Having a suspicion that his drain was not deep enough, and desirous to know what sort of strata lay under it, he took the iron bar, and forced it down about four feet below the bottom of the trench. On pulling it out, to his astonishment, a great quantity of water burst up through the hole thus made, and ran along the drain. This led him to the knowledge, that wetness may often be produced by water, confined farther below the surface of the ground, than it was possible for the usual depth of drains to reach, and that an auger would be an useful instrument to apply in such cases. From his success in this, as well as other modes of draining, and the readiness with which he communicated the principles on which his operations were conducted, to the Board of Agriculture, the British Parliament granted him a reward of one thousand pounds. He taught his art to Mr. Johnstone, who has drawn up a valuable treatise on the subject, from which much assistance has been derived in preparing this Section. It is singular, that another great modern improvement, *warping*, was likewise discovered by an accident. (See Sect. 10.)

† There are instances in Cheshire and Roxburghshire, of lime being applied to a wet soil, without any visible effect; but no sooner was it drained, even some years after, than, without any additional quantity of calcareous matter, it produced luxuriant crops.

‡ Too much moisture in the soil, may prevent springing, for the seed cannot contend with moisture, till it gets green leaves. If there is any risk of wet, the field should be water-furrowed, after the seed is sown.

ing;—and the operations of harvest are attended with perhaps injury to the soil, uncertainty, and danger. On the other hand, when it is thoroughly drained, land can be ploughed at any season with advantage,—it is easily managed, and can be kept clean at a moderate expence,—every exertion of good husbandry is attended with success,—it suffers less from the inclemency of the seasons,—the produce is generally ample,—the quality of the grain is excellent,—and the farmer will thrive, where his predecessor, cultivating a wet and undrained soil, was impoverished, or perhaps totally ruined.

2. *Grass Land.*—The beneficial effects of draining on grass land, are also very great. It is less liable to be poached;—rushes and other aquatic plants soon disappear;—the finer grasses rise in abundance;—the pastures maintain a greater number of cattle and sheep;—the stock becomes superior in size and quality, and less subject to disease*;—that destructive malady, *the rot*, so fatal to sheep, is prevented;—and if the land be mown, the hay produced, is so much improved in quality, as to be of much greater value.

3. *Woods and Plantations.*—Draining is likewise an improvement of the most essential consequence to plantations, where they do not consist of aquatic trees. Land intended for planting the generality of forest trees, if wet, particularly requires draining; for as the roots of trees, penetrate deeper than those of any other plants, the necessity of removing the water in the subsoil, as well as that on the surface, is evident. Where this has been attended to, the plantations thrive, and the trees grow to a considerable size, much faster than can otherwise be expected.

4. *Improvement of Wastes.*—The improvement of wet moors, must be preceded by draining, stagnant water being injurious to all the valuable classes of plants. Care in particular should be taken, to render the land dry, before the application of lime, dung, or compost, otherwise the attempt will be ineffectual. At present, commons lying waste, are, in respect of drainage, in a most wretched state. The soil, in the first instance, absorbs as much water as it can

* In the southern districts of Scotland, particularly in the counties of Berwick, Roxburgh, Selkirk, and Peebles, most of the principal sheep farms have been very much drained, and the consequence is, that the size, quality, and healthiness of the stock in these districts, have been thereby so much improved, as appears almost incredible to those who were acquainted with the former state of sheep-farming in those parts. In many of these farms the rent has increased fourfold, and the rot is now hardly known.

contain, and the surplus water remains on the surface, in a stagnant state, highly injurious to the healthiness of the neighbourhood*.

5. *Melioration of Climate.*—By the removal of stagnant water, and the prevention of noxious exhalations, the climate is rendered more healthy and genial, both to animal and vegetable life†. Indeed, since the introduction of draining into this country, agues, and other similar distempers, occasioned by the humidity of the soil, and the consequent impurity of the atmosphere, have been, in a great measure, prevented; and the general health of the inhabitants has been greatly improved. Much water is discharged into the atmosphere, by spouty land, through the aquatic plants and coarse herbage which it carries; and it is a curious and important circumstance, in an experiment recorded, that while the air immediately above a wet soil, was only 57° of Fahrenheit, the dry part of the same field, and of a similar soil, was considerably higher‡.

6. *Miscellaneous Advantages.*—The drainage of one tract of land, may likewise furnish water, by which the accommodation of another may be promoted, for various useful purposes, as, for irrigation;—for mills, and other machinery; —for supplying houses, ponds, enclosures, canals, or artificial navigations. By peculiar modes of applying the arts of draining also, the quantity of water found in mines and quarries, may be diminished, either by cutting off the resources above, or by letting down that which often impedes their working into a porous stratum below.

On the whole, there are no means by which the value of land can be advanced, or from which, when usefully applied, so many advantages can be derived, at a moderate expence, as that of draining. The owner is benefitted by an increase of rent; the occupier, by that of produce; and the public, by being thus supplied with greater quantities of the most essential commodities, and by having a source of useful employment furnished to the labouring classes of the community. Unfortunately in all parts of the United Kingdom, a great deal of land stands more in need of draining than of manuring; and there are very few districts, where a knowledge of this essential means of improvement, is so general, or so perfect, as it ought to be.

* Middlesex Report, p. 288.
† Oxfordshire Report, p. 231. Derbyshire Report, vol. iii. p. 621.
‡ Forfarshire Report, p. 73.

2. *On the Causes of Wetness in Land.*

To proceed with any prospect of success in the art of draining, it is necessary to ascertain the causes which produce wetness in land, and the different appearances which, according to soil and situation, it assumes. These causes are, 1. Surface-water; 2. Soils absorbing and retaining a superabundant quantity of moisture, either from their own texture, or the quality of their subsoils; 3. Land springs from surface-water; 4. Springs from subjacent water; 5. Back-water from ditches or ponds; and, 6. Floods from rivers, lakes, or the sea.

1. *Surface-Water.*—*On clay soils*, wetness is commonly produced by surface-water. These soils are of different kinds, varying both in their colour and texture; but they all possess, in a greater or smaller degree, those adhesive qualities, which retain the water that falls upon the surface, until it is either drawn off by art, or exhaled by the sun and the atmosphere. Such soils, therefore, can only be relieved from superabundant moisture, by surface-drains.

2. *Absorbing Soils.*—Loamy soils absorb water freely, and swell with it. They usually retain, however, a greater quantity than is necessary. This is particularly the case, when they have a strong and impervious subsoil, through which no water can penetrate. As this surplus quantity is injurious to vegetation, it ought to be got rid of, either by surface, or what are called hollow-drains. Sandy soils, on a retentive bottom, also require draining, as the water cannot descend lower, being lodged in the upper stratum; but there is seldom a necessity to go deeper than a few inches, into the clay, on which the upper soil is incumbent.

3. *Land Springs.*—In many cases, soils are greatly intermixed, and changes of sand and clay, or substances that are porous and retentive, will be found in the same field. Draining, in such cases, is attended with more difficulty, and requires more skill, than where the surface, and internal strata are thick, and regularly disposed. The means by which this can be best effected at a moderate expence, is to ascertain the quality of the soil, by examining its produce. The porous soils collect reservoirs of water, which augment in times of rain, to the full level of the surrounding clay, from which it bursts out, and forms a kind of *temporary spring*, which renders the land over which it flows, wet, and unproductive. It then perhaps is absorbed by another porous stratum, and produces similar effects. Formerly,

this mischief was endeavoured to be remedied by small drains, made over the whole field, which seemed thus to be equally affected; but by cutting a trench, from the nearest and lowest part of the field to be drained, up to the highest and most distant sand-bank, in such a direction, as to pass through the intermediate sand-beds, the soil is radically cured. Besides these main-drains, however, side-cuts are often necessary.

4. *Springs from subjacent Water.*—A knowledge of the causes, and the nature of springs, arising from subjacent water, is so closely connected with the principles of draining, that it is necessary to explain it at more length. The earth is known to be composed of various strata, which, being in their nature and quality of opposite consistence, have acquired the distinguishing names of *porous* and *impervious.* Sand, gravel, calcareous earths, and various kinds of rock, the parts of which are separated by frequent chinks and fissures, are denominated *porous* soils;—clay of various sorts;—certain kinds of gravel, with a mixture of argillaceous and cementing particles in their composition;—and rocks of a solid and compact nature, and without fissures, are the principal strata that resist the admission of water, and are thence termed *impervious.* It is evident, therefore, that springs must originate from water falling, either in the shape of rain, or dew, or the melting of snow and hail, upon such porous and absorbent bodies; and that the water subsiding downwards, until it is obstructed in its passage by these impenetrable substances, there it forms reservoirs of considerable magnitude, which afterwards burst forth in all those different appearances which are met with. Thus springs are formed, the strength of which depends upon the extent of high ground which receives and retains the rain-water, the size of the reservoirs, and the supply they furnish.

5. *Back-water.*—A frequent cause of wetness is, the stagnation of water in the ditches that surround fields, particularly such as lie in the upper side of the enclosure, where the water, being confined, finds its way downwards into the open parts of the subsoil, and oozes out to the surface, forming, in wet weather, all the appearances of, and producing nearly the same effect as, a natural spring. Water conveyed in a drain, or small stream for mills, or confined in a mill-dam, or pond, has often the same effect. Where this happens in drains, the stagnant water should be removed, by giving more depth or declivity to the ditch in

which it lies. Where a dam occasions the mischief, a cut should be made on its lower side, to intercept any water that may ooze through it. Old marl-pits full of water, and cattle-ponds improperly constructed, sometimes occasion this sort of mischief.

6. *Floods from Rivers, Lakes, or the Sea.*—In these cases, the proper remedy is embanking, to be afterwards explained, (Sect. II). But the aid of machinery, is often necessary to assist in the drainage.

3. *The Sorts of Drains commonly used.*

There are four sorts of drains: 1. The open; 2. The covered; 3. The arched; and, 4. The vertical, or pit-drain.

1. *Open Drains, or Ditches.*—These often answer the double purpose of conveying superfluous water, and of enclosing the fields; though they certainly make a hazardous and inconvenient sort of a fence, without the addition of a bank, a wall, a hedge, or a railing.

In cultivated land, where the ridges are of a proper length, breadth, and height, and the furrows of an adequate depth, and skilfully directed, much surface-water may thus be carried off; but where the country is flat, and the soil peculiarly strong, a complete drainage is absolutely essential, as the basis of its future improvement. The mode practised in "*the Carse of Gowrie,*" a district in Scotland, containing about 30,000 acres of rich clay and loam, has been attended with such great success, that it may be proper to explain it, as the same system may be applied to all tracts of clay similarly circumstanced.

The proprietors, by mutual consent, fixed on the most eligible lines for cutting large drains, from fifteen to twenty feet deep, (provincially *pows*), resembling small canals, for conveying the water collected in them to the adjoining river. 2. Ditches of a smaller size, were next drawn, surrounding and intersecting the farms, so as to serve for divisions of the different fields, the water of which they collected, and emptied into the large drain or *pow*. The depth of these ditches was seldom less than four feet; their width at top, six; and at the bottom, from one, to one foot and a half*. 3. Where the fields are of an uniform level surface, the common furrows between the ridges, if sufficiently clear, will keep the ground dry; but, as fields are seldom without some

* They must be scoured annually.

inequalities, the last operation, after they are sown and harrowed, is, to draw a deep furrow through every hollow in the field, in such a direction, as to communicate with the other furrows that divide the ridges, and with the ditches at the extremities of the enclosures. These cross furrows, (provincially *gaws* or gripes), are opened by the plough, but widened, cleared out, and shaped by the spade, to enable them to discharge the water freely*. To keep them clear, is a very essential part of the clay farmer's attention. The effects of this system of drainage are such, as to render the land so free and tender, that less labour prepares the ground for the crop,—less seed is necessary,—less manure is required,—and as neither drought nor damp have any very injurious effect upon the soil, an abundant crop may be expected in all common seasons†.

The necessity of making these *water-cuts*, or furrows, in wet fields, as soon as the plough leaves them, is strongly inculcated, as essential for the future dryness and fertility of the land. The cuts ought to be frequently examined, more especially after the melting of snow, to see that no impediment prevents the free passage of the water. The cutting of water-furrows, ought likewise to be carefully attended to, after spring ploughing, to prevent water from lodging in any part of the field, however wet the weather; and for that purpose, the head-lands should be cut through, where necessary, that water arising from any sudden flood, may have a free passage, the spit of earth dug out of the water-furrows, should be laid on one side, opposite to the rise of the land, to prevent overflowing, and all the loose mould carefully shovelled out‡. This simple operation of *water-furrowing*, is attended with such beneficial consequences, that wetness may often be removed by such means alone, without the aid of additional drains; while the omission of it, may not only lessen the crop, but injure the soil for some time afterwards.

Water-furrowing is likewise of great advantage, in pasture fields; and the cuts, or furrows, ought to be carefully scoured out before winter. The water is thus prevented from lodging and soaking into the soil;—which is then less likely to suffer from poaching;—and the roots of the grass,

* General Report of Scotland, vol. ii. p. 437.

† Husbandry of Scotland, vol. i. p. 61.

‡ Young's Calendar, p. 45, 86, 160, 220, 459, and 468. Too much attention cannot be paid to water-furrowing strong land.

not being chilled by superfluous moisture, will necessarily come forward earlier in spring*.

In open districts, open drains are made of the subjoined shape,

and turfed to the bottom, so that there is no loss of herbage. No water ever stands in these drains, and a part of a county, (the Coventry estate in Worcestershire), that, half a century ago, was a mere morass, has now become, by means of these drains, perfectly dry, healthy for sheep, and fit for cattle†. Mr. Johnstone recommends, that these drains should not be ploughed with the rest of the field, but should always remain in grass; for, if loosened by the plough, the sides might be washed down, and the shape destroyed‡.

It is a general rule regarding open drains, with a view of giving sufficient slope and stability to their sides, that the width at top, should be *three* times as much as that which is necessary at the bottom, and in the case of peat-mosses, or soft soils, it should be still more. In regard to the fall or declivity, it should be such, as to allow the water to run off without stagnation, but not with so rapid a motion as to injure the bottom.

In all drains, it is a rule to begin at the lowest place, and to work upwards, by which the water will always pass from the workman, and point out the level. This enables the labourers also, to work in coarse weather, and prevents their being interrupted by wet, so early in the season, as otherwise might happen.

It is much recommended to all farmers, in low and moist situations, frequently to perambulate their farms, for the purpose of examining the state of their drains, and discovering every obstruction; nor ought even the trace of the mole, crossing an open drain, to escape their notice§.

2. *Covered Drains.*—As open drains rather diminish the extent of surface, and are sometimes injurious to stock, covered drains are in many cases preferred. Here we shall consider,—The season for executing them;—The mode of

* General Report of Scotland, vol. ii. p. 462.
† Worcestershire Report, p. 191.
‡ General Report of Scotland, vol. ii. p. 450.
§ Leatham's East Riding Report, p. 22.

doing it;—Their size;—Whether hollow or filled;—Materials for filling;—Distance from each other;—Duration;—The expence;—The state of the ground;—and, The impediments and enemies they have to encounter.

1. The summer is, in general, the best season for executing such drains, because the labourers can then work with more comfort;—the materials for filling can be more easily collected;—the land is in the best state for bearing the carriage of stones;—and more work can be done in a day*.

2. Drains intended to be ultimately covered, are sometimes made by the plough, as being the least expensive mode. But only small drains can be made in this way; and as drains in general cases, ought to be at least four feet deep, spades of different dimensions must be employed. The additional expence is amply repaid, as the work is done more effectually†. The trench, however, is often begun by the plough, and finished by the spade‡.

3. The size of covered drains must be regulated by the quantity of water to be conveyed away. In point of width, there should only be room to work, unless, from the softness of the soil, a greater slope is necessary. An overwidth increases the quantity of materials requisite to be used in filling, which, in many situations, is an object of no small consideration. The depth should be such, as to allow a proper quantity of earth above the drain, that the materials in it, and what covers them, may not be injured by the pressure of the horses or cattle in the act of ploughing.

4. Covered drains are frequently hollow, where the run of water is large, or the materials good. This last is the case, when the drain is made of stones, either inserted in a triangular shape, or regularly built and covered by flags; or where common or draining bricks or pantiles are made use of. These are preferable to stone in two respects, that they can be more quickly and uniformly laid, and give less interruption to water than the ragged edges of stone. Sod, or turf drains also, are not filled§; nor the clay pipe

* General Report of Scotland, vol. ii. p. 499. In the border districts, they consider March, to be the best period of the year, for determining the proper line of a drain. In that month, if it be dry, the distinction between the naturally wet and dry parts of a ploughed field, is more palpable than at any other season of the year. In that month, accordingly, it is the practice in the border counties, both to mark out, and to work, the drains, while the land is under preparation for turnips. But the same plan would not be equally suitable to wet and heavy soils.

† Young's Calendar, p. 30. ‡ Essex Report, vol. ii. p. 169.

§ They are made by digging a trench of a proper width, not less than three feet deep, and if the last spit is taken out by the narrow under-draining

drains*. These last, however, are better calculated for small aqueducts, for the conveyance of water, than for draining land; as when finished, the water can have no access into them from without.

5. The materials for partially filling drains are numerous; as, *small stones*, which answer for a considerable time, provided the drain be sufficiently wide at bottom, if stones to the depth of at least two feet are used, and they are properly covered;—*bricks*, which are sometimes expressly made for the purpose of draining, and are exempted from duty on that account;—*turf*, or sods, which many recommend in preference to any other substance†;—*wood*, particularly old thorns, cut into billets, which are well calculated for soft or peaty soils, that are unable to bear the weight or pressure of stones;—*green bushes*, not in leaf, (in some situations green willow is known to have lasted for ages)‡;—*black-thorn*, which is a favourite material in Essex;—*heath* or *ling*, which has been found a durable substance;—*fern*, *furze*, or *broom*;—and where the drain is small, and better materials cannot be had, even *straw*, either loose, or twisted into ropes as thick as a man's leg. The durability of the materials, at the same time, is of less consequence in clayey soils, than the probability of having a sufficient opening for the water to flow through, for clay sometimes forms an arch over these materials, capable of supporting the incumbent soil, and leaving a clear passage for the water below when they decay. The materials must be covered with loose straw, stubble, fern, rushes, or turf, before the mould is thrown in. The drains should be filled up, as soon as possible after they are ready for that purpose, and by the

spade, a shoulder is left on each side, upon which a sod or turf is laid, grass-side downwards, and the mould thrown in over it. These are the least expensive drains of any, and may continue hollow, and discharge well, for many years.

* A drain is dug to the necessary depth, as narrow as possible, in which is laid a smooth round piece of wood, ten or twelve feet long, five inches in diameter at one end, and six at the other, to which a ring and rope are fastened. After strewing a little sand in the bottom of the drain, and on the upper side of the tree, the toughest part of the stuff thrown out of the trench, is first laid in upon it, and then the remainder firmly trodden down. By means of the ring and rope, the tree is drawn to within a foot or two of the small, or hinder end, and the same operation is repeated. Such a piece of wood dragged along water-furrows, would be of much use in giving a proper shape.

† Marshall, in his Midland Counties, vol. i. p. 139, gives a particular detail of *turf-draining*, which he greatly prefers to the Essex method of *bush-draining*, by which the drain is filled with perishable materials.

‡ Middlesex Report, p. 292.

most careful of the workmen. They should at any rate be completed before winter, for, if exposed to frost, they are apt to crumble down.

6. When the soil is very wet, it will be necessary to cut the small drains near each other; from forty to fifty feet distant in common soil, and from twenty to thirty feet in the more stubborn*. But deep and large ditches must be cut around wet fields†, into which the water, from the smaller drains, is to be conveyed.

7. When done with common skill and attention, drains will last for 20, 25, or 30 years, and in many cases they have endured much longer.

8. The expence is calculated at from 20*s.* to 60*s.* per acre; except in very wet soils, where it is sometimes higher than even 60*s.*; but in most cases the whole of the expence is repaid by the first arable crop.

9. The best period for making these drains, is, when the land is in grass, or in fallow.

10. Hollow drains have several enemies, as moles, field mice, the roots of trees, (in particular the poplar, and the ash‡), and a plant which sometimes grows in them, intercepts the course of the water, by degrees weakens the current, and at last chokes up the drain §.

3. *Arched Drains.*—The expence of arched drains, of stone, or brick, prevents their being adopted, unless where the ground is very loose, or where open drains are inadmissible. Where flat stones abound, drains covered by them, may in general be made large enough, for every essential purpose‖.

4. *Vertical,* or *Pit Drains.*—Drains of this description may on some occasions be useful. If the spot where a confined reservoir of water exists, can be ascertained, (which sometimes may be done by boring with an auger), sink a pit into the place, of such a size, as will allow a man to work within its bounds, (or about three feet in diameter), until it reaches the water meant to be brought up, which will rise as soon as the pit reaches it. The pit should then be filled with land stones, or pebbles, and the water be conveyed by

* Essex Report, vol. ii. p. 169.

† Derbyshire Report, vol. ii. p. 397.

‡ Marshall on Landed Property, p. 107.

§ This plant, (the *equisetum palustre*), was first noticed by Mr. Farey, in the drains near Woburn Abbey. A description of it is given by Sir Joseph Banks, in the Communications to the Board of Agriculture, vol. ii. p. 349. It belongs to the genus "*Conferva.*"

‖ Marshall on Landed Property, p. 98.

a proper drain, to some adjoining ditch, and thence to the nearest stream or river *.

Spouts or springs also, rising in the middle of a field, may, on some rare occasions, be led into a pit sunk through the clay, and the water may thus escape downwards, into a porous substratum†.

4. *The Instruments employed.*

The instruments employed in draining, are more numerous than is commonly imagined. The principal are,—draining ploughs;—the miner;—the mole-plough;—spades, of various sorts;—the sod knife;—and the auger.

1. The *common plough* is frequently used to open the trench; various sorts of ploughs have likewise been invented for that special purpose, and premiums given to the inventors; but from the number of horses or oxen required to work them, ploughs, calculated for *effecting hollow-draining*, are more expensive than the spade, and never can come into general use.

2. In Lancashire, an instrument called the *miner*, was invented by the late Mr. Eccleston. It is a sort of ploughshare fixed in a strong beam, without mould-boards, and is drawn by four or more horses, along the bottom of a furrow made by a common plough. Without turning the substratum, it penetrates into, and loosens the soil, eight or ten inches deeper than the plough had before gone; which operation, besides draining the land, renders the subsoil open or porous for several years, and causes the water to carry with it any noxious matters in the soil‡. This, in particular cases, is considered to be a useful practice, and the expence is inconsiderable.

3. A particular account is given, in a valuable work, of the first experiments with the *mole-plough* invented by Mr. Adam Scott§. It was originally tried in the year 1795-6, under the auspices of the Society of Arts in London. The addition of wheels was then recommended, which has since been carried into effect. The accounts of the advantages resulting from this instrument are extremely contradictory. It has no doubt been effectual, when well applied. It will succeed, where there is a regular stratum of clay or stiff marl; but not in loose, nor in mixed soils.

* Brown's Treatise on Rural Improvements, vol. ii. p. 256.
† General Report of Scotland, vol. ii. p. 457.
‡ Holt's Lancashire, p. 33, and p. 107. § Middlesex Report, p. 289.

Without wheels, it requires from ten to fourteen horses, the trampling of which must be extremely injurious to wet soils: but with wheels, the team may be reduced to six horses*. It is sometimes worked, with a peculiar apparatus, by manual labour†; but it can never become generally useful, until *a moderate power*, whether of man or horses, is sufficient to impel it.

4. The spades used in hollow-draining, are of a peculiar construction. The upper, or *top-draining spade*, is narrow at the end, and the spade used for the lower part, or bottom tool, is almost pointed. A narrow scoop also is used for smoothing, and cleaning out the bottom of the drains, previous to the wood, straw, or other materials being put in. A breast-draining spade has also been invented, and is found useful: it is the common paring spade, with both sides turned up; and is driven forward by a man in the same manner‡.

5. *A sod-knife*§ is useful in setting out the trenches, the workmen treading it in by the side of a line, five or six inches deep. It is more expeditious, and easier to the workmen than the spade.

6. *The borer*, or auger, used in draining, is very similar to that employed in searching for coal, or other subterraneous minerals‖.

5. *Modes of Draining applicable to different Soils, and the Objects to which they are applicable.*

1. *Clays.*—It is a subject of great controversy, to be afterwards discussed, (Chap. IV. Sect. 1. § 1.) what is the proper breadth of ridges, in a clayey soil, with a view to drain it. The only point necessary to be here touched upon, is, whether, in clays, the drains should be open, or covered. In general, the open are to be preferred, being less expensive to form, more easily kept in order, and more certain in their effect. At the same time, in some particular cases, covered drains have succeeded. In the Duchy of Limberg, they

* Young's Calendar, p. 35.

† The apparatus is described in Rudge's Gloucestershire, p. 261.

‡ Leatham's East Riding Report, p. 30.

§ In fen countries, called a "*Hodding spade*," from its use in digging peats for firing. These, of a certain size and shape, are called "*Hods*."

‖ There is a particular description of this process, with engravings, in the General Report of Scotland, vol. ii. p. 492. See also Derbyshire Report, vol. i. p. 318.

prefer having such drains in the furrows of strong land, by which less ground is lost, and the soil is rendered at all times accesible to culture*. The celebrated Arbuthnot, (who is characterised by Mr. Arthur Young, as the best farmer he ever met with, in the course of his long experience)†, practised that system near Mitcham in Surrey; and an intelligent Scotch farmer, (Mr. James Andrew, at Tillylumb, near Perth), has carried the same plan into effect, with the greatest success: he was formerly at the mercy of every season, and found none so dry, but that in a certain degree he sustained some injury; but since he has adopted the plan of a hollow drain in every furrow, he can plough almost at any time; the seed can be put in, if there be but a single dry day; in the ordinary course of things he can always rely upon a crop; and the soil being nearly of the same quality, and in a similar state, the crop is always equal‡.

2. *Loams.*—When loams are allowed to rest, they sometimes acquire a degree of cohesion, little inferior to clay. They generally absorb water rather freely, and after retaining a proper quantity for vegetation, they allow the superfluity to run off, where there is a descent; but that operation is facilitated by hollow-drains, water-furrows, and ditches, which collecting the water, operate like veins, and convey it to a large drain made for carrying it off.

3. *Meadow Land.*—Along the sides of rivers or smaller streams, much valuable land is met with, injured by water. Sometimes land in this situation is protected from the overflowings of the river by embankments, as ought to be done with respect to the fine meadows in Derbyshire and Staffordshire, on the banks of the Dove§; but it frequently happens, that by deepening the river or stream, or, in other cases, by making a new, straight, or deeper channel, a considerable addition may be made to the land, and the object of drainage effected. Sometimes the wetness arises from springs, which issue from the bottom of an adjoining high ground. With much ingenuity, Mr. Edward Webbs, of Stow, in Gloucestershire, has employed water collected by

* Hints on the Agricultural State of the Netherlands, p. 73.

† Young's Lecture on the Husbandry of three Celebrated British Farmers, p. 18.—It was Arbuthnot who first discovered the merits of the South-down breed, now held in such high estimation.

‡ Husbandry of Scotland, vol. i. p. 56.

§ Derbyshire Report, vol. ii. p. 494.

the upper drains, to drive a wheel, by which the water is pumped from the lower parts, and carried off*.

4. *Upland Pastures.*—The draining of upland pastures is an important branch of the subject. From the unwholesome quality of the plants produced on such pastures, where there is a superabundance of moisture, whether stagnant on the surface, or confined under it, proceeds that most destructive malady, *the rot*, and other diseases, to which many thousands of valuable animals fall a sacrifice every year. In the sheep farms of the Cheviot hills, the object has in a great measure been obtained, by cutting surface-drains, about one foot wide, and as much deep, in an oblique direction to the declivity of the ground†. Others have been rendered dry, by the following simple process: A deep furrow is turned up, by a strong plough; the sod is cleared from earth, reduced to three inches in thickness, and thence placed in the furrow whence it was taken. The grassy side being placed uppermost, there is a hollow beneath, sufficient to discharge a considerable quantity of surface-water, which readily sinks into it‡. The water collected from these drains, is sometimes employed in running over such parts of the ground below, as are dry and covered with heath, where it has the effect of killing that plant, and encouraging luxuriant grass§. No mode of improvement is attended with more benefit, or occasions less expence||.

5. *Bogs.*—The successful mode of draining bogs, as practised by Elkington, and so ably described by Johnstone, cannot be minutely detailed in this place; it may be sufficient to state the general principles upon which it depends: these are, 1. Upon discovering the main spring or source of the evil; 2. Upon taking the levels, and ascertaining their subterraneous bearings; and, 3. On making use of the auger when necessary, if the depth of the drain is not sufficient for that purpose, to reach and *tap* the springs. As an example of this, it may be mentioned, that in a field near Tamworth in Staffordshire, by boring a hole thirty feet deep, through which water issued at the rate of *three hogsheads a minute*, a great extent of wet land in that neighbourhood

* Gloucestershire Report, p. 263.

† Northumberland Report, p. 128. ‡ Brown's Treatise, vol. ii. p. 361.

§ General Report of Scotland, vol. ii. p. 446.

|| The expence varies in different cases, from three farthings to six farthings per rod of six ells. There is a person near Peebles, who will contract for executing such works, and will give in an estimate of the expence.

was laid dry. Indeed in several cases, the Elkingtonian system has been attended with extraordinary consequences, not only in laying land dry, in the vicinity of the drain, but also by having a material effect on springs, wells, and wet ground, at a considerable distance, with which there was no apparent communication*.

6. *Lakes.*—The objects in the draining of lakes are threefold: 1. For the sake of the land that may be gained, when the water is removed; 2. For the marl and rich earth that may be got at the bottom; and, 3. For the purpose of obtaining a level to drain the tracts of meadow, and marshy ground adjoining, which cannot otherwise be accomplished. In this way, the climate in the neighbourhood may likewise be improved. In many cases, such pieces of water have been either partially or entirely drained by deep cutting only, but sometimes, the aid of machinery is required.

7. *Land-locked Bogs, or Morasses.*—In several parts of the kingdom, there are bogs of this description, which become wet by an accumulation of rain-water, stagnating on an impervious subsoil, through which it can have no descent, and being surrounded by higher ground, through which there is no vent, the water cannot be discharged. The proper mode of draining these land-locked bogs is, by perforating the impervious bed of clay, on which the water rests, if any such exists, and letting the water downwards into a sandy, or other porous stratum†.

8. *Mines and Quarries.*—In many cases, the workings of mines and quarries are obstructed, by a flow of water, which, by attention to drainage, may be either entirely removed, or diminished, before it reaches the mine or quarry. For that purpose, it is necessary to drain all ground lying higher than, or contiguous to, subterraneous pits and mines. The water that gets into the pit, may, on some rare occasions, be got rid of, by boring through the close or impervious bed, to the absorbent strata below.

Concluding Observations on Draining.

So sensible are landed proprietors become, of the deep interest they have, in executing this most important species

* The borings and pits made and sunk by colliers, in various parts of Great Britain, had the same effect.—*Derbyshire Report*, vol. i. p. 501. But till the time of Elkington, it never was the case in making drains.

† General Report of Scotland, vol. ii. p. 456.

of improvement, on a liberal and extended scale, that it is a practice with many, to have a *general plan* for the drainage and regular division of the different farms, when their estates are newly let; thus availing themselves of an opportunity, to have the plan executed in a methodical, substantial, and permanent manner, under professed drainers and labourers, solely employed in this essential work*. On this great scale of drainage, the connexion of one farm, or part of an estate, with another, renders the effect more complete, and the ultimate charges much less. Indeed so sensible are the tenants, of the advantages of this system, that they give it a preference to that of having the work done at their own expence, with the certainty of indemnification, and in their own manner†.

While such are the advantages to be derived from draining, it is unfortunate that any obstacles should exist to the execution of such a useful improvement. Unless Parliament, however, will direct its attention to the subject, and enact regulations for the encouragement of draining, the efforts of private individuals will often be checked, and much valuable land will continue unproductive. A more complete exemption from the tax on draining bricks, would be of great use. A law might also be passed, authorizing proprietors, even on entailed estates, to charge their land with three-fourths of the expence of drains, as they can at present of enclosures ; and to compel the neighbouring proprietors, to be at a share of the expence of draining, if they derived any benefit from it, as is the case in Scotland, when fences are made on the boundaries of different estates.

The laws of a nation ought to be improved from time to time, to keep pace, with the accessions of knowledge which the people acquire, and with the necessities of the country, as it becomes more populous. The Code of Rural Legislation of Great Britain, unfortunately, has not improved in the same ratio with its increased population, and thence it is as little calculated for the number of its inhabitants at this time, as its produce, a century, or even half a century ago, would now be sufficient for their maintenance. It is not here meant, that the law should interfere with the rights of

* Derbyshire Report, vol. ii. p. 361, and 382.

† It is not unusual to divide the business of draining between the landlord and the tenant. By the former the drains are made, in a proper direction, and of a proper depth; while the tenant bears half the expence of procuring the stones, leading them, and placing them in the ditch. The landlord should appoint the men to put in the stones, and to fill up the earth.

private property, farther than the public good absolutely requires. More effectual regulations, however, for promoting cultivation, drainage, and enclosure, ought now to be enacted, the existing laws being imperfectly calculated for promoting these essential improvements*.

Sect. IV.—*On Manures.*

The term *manure*, includes all those substances, which, when artificially applied to, or blended with the soil, are known from experience, either to retrieve, to maintain, or to augment its fertility, and to render it, in any respect, more favourable to vegetation. This includes all the articles, which tend to correct any noxious ingredients in the soil, or to turn to greater utility, certain substances previously contained in it†.

In discussing this subject, attempts have been made by various authors, to arrange these substances in a philosophic manner, and to explain their properties on chemical principles. In this work, restricted to practical information, it is proposed to classify them under the general heads of Putrescent ;— Calcareous ;— Earthy ;—Vegetable ;— Those of a miscellaneous nature ;—and Composts.

1. *Putrescent Manures*‡.

These unquestionably are the most important of the classes above enumerated. They not only supply the soil directly with the principal sources of fertility ; but having a tendency to produce a strong germination at first, plants have thence a better chance of reaching maturity. Putrescent substances being of a nature susceptible of decomposition, are ultimately exhausted, when the soil has yielded crops for any course of time. It is necessary therefore to

* A real statesman should always keep this maxim in view, "That laws ought to change with the circumstances of a country; and above all, that the same system, which might be calculated to govern, and to secure the sustenance of six millions of inhabitants, will not answer equally well, when the population has increased to twelve millions, or upwards." The changes, however, should be gradual, and at a proper season. If they are too long pertinaciously resisted, the evil increases, too many alterations must be made at once, and the changes are then attended with the hazards of convulsion.

† Coventry's Discourses, p. 37.

‡ Called *putrescent*, being liable to natural decomposition or decay.

replace them; and the articles which may be employed for that purpose, are comprehended under the following heads: The dung of quadrupeds;—the dung of birds;—town dung;—night soil;—urine;—land animal substances;—and fish.

1. *Dung of Quadrupeds.*—This valuable substance, furnishes immediate food to plants;—excites heat in the soil;—opens its texture;—attracts and retains moisture;—and promotes the decomposition of vegetable particles in the earth, by the fermentation it occasions. Where animals chew the cud, the dung is so thoroughly reduced, that it may be incorporated with the soil, without requiring to be collected in a dunghill; but on many accounts, a mixture of hot and cold, of dry and moist putrescent substances, in the same heap, is found to be advantageous.

The subject of farm-yard dung, practically considered, includes, 1. Collecting the materials; 2. Preparing them for use; and, 3. Applying them to the soil.

1. *Collecting the Materials.*

1. Farm-yard dung consists of the excrements of various animals, mixed with their litter, and such other absorbent articles, as are calculated to increase the quantity, without injuring the fertilizing quality of the mass. Even weeds of all sorts, may with safety and advantage be collected for that purpose in summer;—also leaves of trees, and shrubs, which are often to be obtained in considerable quantities in autumn;—straw, and chaff, not used as food or litter;—likewise vegetable mould, or peat earth.

2. The most essential article, however, is, the excrements of domesticated animals. Of these, the dung of the hog, owing to the greater fatness of the animal, and the nature of its food, is the strongest and richest;—that of the horse, the dryest and most heating;—that of neat cattle, the coldest, but the most lasting*. The dung of sheep is seldom mixed with other articles, and being only calculated for immediate use, is soon exhausted.

3. It frequently happens, that the dung of horses is separately used, particularly when taken from towns; but in

* In some experiments made at Great Ponton, near Grantham, on a poor dry soil, the manure from a horse-yard, and that from a yard where neat cattle were wintered, were used separately for turnips; the former had greatly the advantage. It would have been right to have tried the effect of a mixture of the two.

farm-yards, there is an opportunity of mixing cattle, horse, and hog dung, which is always to be preferred, as the one corrects the defects of the other, and prevents the fermenting process from going too rapidly forward. These substances should be laid, *stratum super stratum;* which can easily be done every day, when the stables, cow-houses, and hog-sties are cleaned out*. If a small quantity of earth can be put between each stratum, so much the better.

4. The quality of the dung of every animal, will in a great measure be proportioned to the richness or poverty of its food†. Hence the dung from the stables and cow-houses is preferred, to that of young cattle kept in the farm-yard, on food of a less nourishing quality. It frequently happens, however, where stock are kept in sheds, or *hammels*, connected with the farm-yard, and liberally supplied with turnips, carrots, and other nourishing articles of food, that dung, equal to any to be otherwise obtained, is furnished.

5. Next to animal excrement, straw is the chief material of a dunghill; and too much attention cannot be paid to collecting it. For that purpose, the greatest care is taken by the diligent husbandman, to cut his crops low. When reaping is carelessly executed, it has been calculated, that one fourth part of the straw is left upon the ground, where its strength and substance is wasted, by the rains and storms of autumn and winter; whereas by attention to the reaping process, one ton, and even more, of additional manure, *per acre*, may be obtained‡. The value of straw is great, not only in consequence of its own substance, but from the quantity of liquid matter it absorbs. By an experiment carefully made, it appeared, that dry wheat straw, by absorption, had increased in weight, from 300 to 719 stone, making an increase of not less than 419 stone, during a period of seven months‡.

6. It is a good rule, to lay a stratum of peat,—mould,

* The propriety of this mixture of the dung of various animals, is very ably enforced by Mr. Elaikie, in his short tract, "On the Economy of Farm-yard Manure, and on other Rural Subjects," p. 3, &c. &c.

† Middlesex Report, p. 305.

‡ Brown's Treatise on Rural Improvements, vol. i. p. 367, 368.

§ Communication from Mr. Dudgeon of Prora, in East Lothian, of an experiment made in 1814. Mr. Brown of Markle states, that if straw were simply to be rotted by moisture from the heavens, the original weight would be thereby doubled; but when rotted by the urine and dung of turnip-fed stock, there can be no doubt, but that for every ton of straw carried to the fold-yard, four tons of dung will be carried to the field, provided the manufacturing process has been properly conducted.

—marl,—chalk,—scourings of ditches, and other earthy substances, on the surface of the farm-yard, before the dung is collected, in order to absorb those valuable juices that otherwise would be lost*. This forms a rich compost at a small expence. It should be turned and mixed soon after the cattle are removed out of the farm-yard: it will thus be brought into a most advantageous state, either to be spread upon the grass land in October, or on the arable, as a top-dressing in spring.

7. As in heavy rains, notwithstanding every precaution, some water will run from the yard, there ought to be a covered reservoir to receive it, so situated, that the liquid can either be pumped upon the dunghill, if it requires it, or upon heaps of earth, collected for that purpose†. The stables and cow-houses ought also to be regularly washed, as is done in Flanders; and much useful matter might in this way be collected, and conveyed to the reservoir. Where land lies conveniently beneath the farm-yard, the contents of this reservoir, or the overflowings of the dung-yard, may be conveyed to it, for the purposes of irrigation‡.

2. *Preparing the Materials for Use.*

On this head there is a great diversity of opinion, some contending, that dung cannot be used too soon after it is made: and others, that it cannot be too much rotted. The various circumstances of climate, soil, and crops to be raised, render different practices equally proper.

Much depends upon the climate. The farmers of Picardy, and other parts of France, for instance, may find *the continual carrying on* their dung practicable, but this cannot be accomplished in less favourable climates. What is found beneficial in warm climates, will not answer in a cold one. Besides, in wet soils and cold climates, when the dung is bestowed only in small quantities, so little of it is kept to-

* Mr. Arthur Young's Essay on Manures, p. 153. This valuable Treatise is contained in the 10th volume of the Papers of the Bath Society.

† This liquid might likewise be conveyed in water-carts to the fields, and applied, by means of a gardener's watering pot, to fresh planted cabbages, or savoys, and on some occasions to the potatoe-crop, or to meadow land. This is constantly practised by several intelligent farmers.—*Communication from John Middleton, Esq.*

‡ Marshall on Landed Property, p. 168. This author recommends, that the reservoir should be furnished from time to time, with a flooring of good mould, to absorb the sediment which the liquor will let fall. See also an account of a tank at Bradby Park, Derbyshire Report, vol. ii. p. 454.

gether, that fermentation in the ground is retarded, until it is too late to be of any material use to the crop sown with it.

The advantage of using fresh dung, must also depend upon the soil. Practical farmers are in general of opinion, that long dung is more applicable to strong, than to light land; and as it has a tendency, by its fermentation, to divide and to loosen the constituent parts of the soil, and furnishes matter which prevents the particles of clay, from coming into contact, and adhering together, it must necessarily have a much more desirable effect, on soils too compact, than on those already too light and open*. Hence, it is recommended, on a true *carrot soil*, to use dung, after all its parts are dissolved, and incorporated into one complete mass, by means of putrefaction†.

In regard to the crops, it is remarked by Sir Humphry Davy, that straw fermented, is a more manageable substance, *and furnishes more manure for a single crop*, than unfermented. In the latter state, it decomposes more slowly, and consequently, though its influence will be more lasting, yet it produces at first, less effect. But in the case of turnips, under a proper rotation, the first crop is all that is necessary to manure; the dung given to that crop, more especially when the crop is consumed upon the land, being the means of fertilizing the whole course of succeeding crops, whether barley, clover, wheat or oats.

For raising potatoes, the dung of horses alone, from its heating quality, may perhaps be used nearly fresh from the stables, as it will ferment in the ground. It is this dung *alone*, that some practical farmers mean, when they talk of fresh dung‡. But in a cold and wet climate, dung ought to be moderately fermented, before it is inserted in the ground. The utility of fermented dung, is proved from the little advantage derived from what is dropt upon the ground, and has not undergone that process.

Some farmers are of opinion, that stable-yard manure, should never be stirred, till finally carted to the field, and deposited in the soils; for that every time it is stirred, its finest and most valuable parts escape into the atmosphere.

* Young on Manures, p. 158. † Middlesex Report, p. 300.

‡ Mr. Roberts of King's Walden, would always carry *stable dung*, long and fresh to the land; but he thinks that *farm-yard manure* should be turned up once, yet not kept too long.—See Young's Essay on Manures, p. 146. Mr. Wilkes also speaks of dung taken from *the stable-yard*.—Ditto, p. 148. An intelligent farmer recommends *half-rotted* litter.

But few occupiers are possessed of strength sufficient, to manage the manuring of a large farm, on this system, and at the same time to carry on the operations of ploughing, harrowing, &c. It is therefore thought most expedient, to remove the dung, from the yard in which it has been collected, and to place it in heaps near the fields where the crops are to be sown*. This may be effected, either, 1. Early in the season; or, 2. Late in spring. The plan of management should vary in these different cases.

1. *Early in the Season.*—When it is expedient to remove the dung to the turnip fields, early in the season, large quantities of clay, marl, or such other substances, should be collected for the reception of the dung heaps. The bottoms for these heaps should consist of from six to eight inches of these materials, and the dung should not be thrown loosely upon them, to cause fermentation, but the carts with their loads should be drawn upon the heaps, for the purpose of compressing the dung, and thereby *preventing fermentation*, until the proper period arrives. The dung should be spread regularly, so as to render the ascent easy, for the succeeding teams, as they come with their loads. When the heap is completed, it should then be covered with marl, clay, or earth, so as effectually to enclose the dung heaps, *in crusts*. The dung is thus preserved in *pies*, (as these heaps are called), without loss from exhalation or evaporation, and in an unfermented state. A fortnight before the manure is required for the turnip grounds, these pies ought to be carefully turned over, and thoroughly mixed. They should be again covered with earth, and a fermentation will then take place, by which the compost is brought into an excellent state of preparation, as a manure for turnips†.

2. *Late in Spring.*—When the dung is taken out of the yards, only a short time before it is wanted for the turnip crop, bottoms should be prepared, as formerly directed, but the dung should not be carted upon the heaps, to compress them, and to prevent fermentation, but should be thrown up lightly with the fork, upon the bottoms, so as to favour it. The pies, when completed, should be covered with

* This is the plan of that distinguished Agriculturist, Mr. Curwen, of Workington Hall in Cumberland, whose farm produces, on an average, 10,500 single-horse carts of manure per annum. Such a quantity of dung could not be managed on any other system.

† Blaikie on Farm-yard Manure, p. 13.

earth; they will soon take a gentle fermentation, and be ready for use*.

From the great expence of cartage, more especially to the remote parts of the farm, Mr. Curwen thinks it expedient, to reduce the cubical contents of the putrescent manure to be employed, before it is removed to its ultimate place of destination. By this reduction in weight, as well as in bulk, one third of the cartage is saved, and the manure is of a more valuable quality†.

When turnips are sown *in drills*, there cannot be a doubt, that rotten dung, recently applied, is essential for that crop‡. This is the opinion of every intelligent farmer who practises that system. The bulk of the manure is certainly diminished; but the expence of its conveyance, and the labour of depositing it in the ground, are lessened;—and it becomes much more manageable.

The old practice, of *frequently* stirring, turning, and mixing the dung, without, in general, even covering the heap with earth, when it was turned, is now generally laid aside by every judicious farmer. Even for a crop of drilled turnips, one, or at the utmost two turnings, will be sufficient. After each turning, the heap should be carefully covered with a stratum of porous earth, to catch the rising vapour, and to retain the volatile matter, which would otherwise escape. Indeed some farmers are of opinion, that dung may be sufficiently fermented to be applied to crops of grain or grass, without any turning, provided due attention be paid to the previous steps of preparation.

* Blaikie on Farm-yard Manure, p. 15; where the process is more minutely described. The dung thus prepared, gets into a fine condition, being at once heavy, short, and mellow. Dr. Rigby's Report, p. 56. By this improved method of preparing dung, Mr. Coke has saved 500*l.* per annum in the price of oil-cakes, and his crops of turnips are as good, if not better, than before.

† Curwen's Report, p. 62.

‡ Mr. Walker of Mellendean, who rents about 2800 acres of arable land, has found by the experience of thirty years, that a small quantity of rotten dung, is sufficient for that crop, and if the soil and season are suitable, will almost always ensure, not only a good crop of turnips, but that all the succeeding crops, according to the common rotation, are good; but he never could raise a full crop with long fresh dung, which, from its openness, tends to admit drought, instead of affording moisture and nourishment to the roots while they are young and tender. He is therefore at a considerable expence, in carrying out, turning, and watering his dunghills, *so as to have the dung in a putrid state, when laid on the land in June.* After all, he is obliged every year to manure a part of his turnip land with fresh dung, and wherever that is laid on, the crop is invariably much inferior.—*Husbandry of Scotland*, vol. i. p. 161.

It is highly dangerous to use unfermented dung with corn crops, as it may contain the eggs of insects, and the seeds of weeds, which nothing but fermentation can destroy. Unless, indeed, the crops were to be hoed, it would be sowing the seeds of weeds, without ensuring their destruction*.

In the Netherlands, the greatest possible attention is paid to putrescent manure. The more opulent, pave and line with brick, the receptacles for their dung, which is thus kept constantly plunged in a mass of liquid matter. The fibrous parts of the vegetables, are thus completely decomposed, and four tons of this manure, go as far as five, collected and kept with less precaution.

3. *Mode of Application.*

Dung is applied to,—Fallows;—Green crops;—Corn crops—or Grass. This last mode of application will be noticed, when the subject of grass lands is treated of.

1. Strong soils, not in a high state of fertility, when subjected to the fallow process, are manured with dung; and if the land is *thoroughly cleaned*, the dung will be applied, with more advantage to the occupier, than in any other stage of the rotation. It ought to be spread the moment it is taken from the cart, and completely incorporated with the soil†.

2. The best application of farm-yard dung, in the case of light soils, is to green crops of every description, more especially when the manure is placed in the centre of the drill, to crops of turnips or potatoes‡. In Flanders, they have a practice which is attended with nearly similar effects. After the dung is spread on the surface of a field to be ploughed, and a furrow has been made, a person with a fork or a rake, goes before the plough, and throws from the surface, into the furrow, as much manure as has been placed upon the soil that the plough will turn over, *the next bout*. The dung is thus put at a proper depth, and not liable to evaporation.

3. Farm-yard dung is likewise applied to clover stubbles, upon which wheat is to be sown; that crop requiring the

* Communications to the Board of Agriculture, vol. i. p. 238.

† General Report of Scotland, vol. ii. p. 520.

‡ When used in this way for turnips, the dung should be made as moist as possible, to promote a rapid vegetation. In cultivating carrots and parsnips, the dung ought to be thoroughly reduced, and *placed deep in the ground*, so that the roots shall not reach it, otherwise they become forked, or divide.

land to be in a very fertile state. In some districts, the clover stubble is likewise manured for oats.

There is a singular mode of applying dung in some districts in Switzerland. The farmers there, consider liquid manure as the most efficacious of any, and thence, *after the dung is fermented*, they dilute it in water, and the liquid alone is carried to the field, and scattered over it. The earth immediately imbibes the liquid, which soon reaches the roots of the plants, and causes a rapid vegetation; whereas it is a long time before dung, in a solid state, fertilizes the soil. The straw that remains, after the dung is thus washed, is applied as manure for potatoes*. In strong clay soils, however, liquid manure would not be so efficacious as long dung.

The quantity of dung to be applied, is an important question. Formerly too much was given, and the crops were surfeited with a profusion of nourishment. According to modern practice, only as much is furnished at one time, as will fertilize the ground, and render it capable of producing good crops, until a fresh supply can be administered†. Formerly, from twenty to thirty tons were given, per acre, whereas, now, one half of that quantity is found to be sufficient‡. It was formerly supposed, that putrescent manure was durable, in proportion to the quantity applied, without considering that a great quantity rather accelerated than retarded decomposition, and that the consequence must necessarily be, unprofitable fertility the first year, and disappointment during the succeeding ones. A happy medium, however, ought to be kept in view; for manures ought not to be applied too sparingly. If dung to the value of only 1*l.* per acre is given, it may not refund the expence; whereas by laying out at the rate of 3*l.* per acre, the profit may be considerable.

Whatever quantity is used, the dung should be spread equally, and divided so minutely, that every part of the ground may receive an equal supply§. This cannot be done so very equally, when the manure is laid in drills, for crops of turnips or potatoes; though even in such cases, it ought not to be neglected, so far as it is practicable. To promote

* Hints as to the Agricultural State of the Netherlands, p. 67. Lord Kames likewise recommends liquid manure.

† Brown's Treatise on Rural Affairs, vol. ii. p. 384.

‡ General Report of Scotland, vol. ii. p. 518.

§ This is particularly necessary, when applied to a crop of barley, the ripening of which, ought as much as possible to be simultaneous.

that equal division, the drills are sometimes drawn across the field, and at other times diagonally; or by cross-ploughing, after the crop is taken up, the dung in the drills is mixed with the soil.

The last point to be considered is, the depth at which the dung ought to be placed. If applied to grass land, it can only be spread upon the surface, and all the advantage possible in that case to be derived from it, is, the fertilizing matter washed down by the rains. When applied to arable land, it is strongly recommended, to cover the dung well. But here, as in every thing else, extremes ought to be avoided. Dung is of use to plants, either from the gases it emits, or by the nourishment which it furnishes to them, when in solution with water. The gases will rise, and it is of less consequence, in that respect, to what depth the dung is put; but a solution of water *will sink*, and ought not to be placed beyond the reach of the roots of the crops for the nourishment of which it was intended.

The superior importance of farm-yard and stable dung, (which have been justly denominated, the farmer's *sheet-anchor)*, has rendered it necessary to dwell on that subject at greater length, than is practicable in regard to any other manure, consistently with the intended brevity of this publication.

It now only remains, under the general head of dung from quadrupeds*, particularly to mention that of sheep.

Sheep-Dung.—This valuable article is collected in several ways. In various parts of the Continent, sheep are kept in houses during almost the whole year, for the sake of their manure.—When they are fed along the sides of roads, young children are employed to collect the dung they have dropt.—Sheep fed on upland pastures, are folded in the vale on arable land†; and when crops of turnips or of rape are

* It may be proper to add in a note, that a zealous friend to agriculture, (John Fane, Esq. Member for Oxfordshire), manures about 26 acres yearly, with the dung of rabbits, kept solely for that purpose. The skins and carcasses pay the expence, and the manure is all clear profit.—*Oxfordshire Report*, p. 316. But the plan could not be carried to any great extent, as there would not be a market for the carcasses.

† This is a point that has been much controverted. It is contended, on the one hand, that the immediate application of dung and urine to all soils, and of treading to loose ones, are so well known, that no doubt can be entertained of the profit of the practice. Indeed, on many light soils, very little wheat would be raised without it; the manure, which, scattered over a large surface, would be of little or no use, when collected, may prove highly

grown, these useful animals are folded upon the crop, which they consume upon the ground, and enrich the soil with their dung and urine.—Sheep fed on linseed-cake, produce an extraordinary fertilizing dung, by which any poor land, whether it be arable or pasture, may be speedily enriched.—A most useful plan has recently been adopted, that of folding sheep upon straw in the corner of the turnip field, and carrying the turnips to them*.—This is particularly suitable for such soils as are too wet or tenacious to have turnips fed upon them; or on sloping grounds, where the manure might be washed down.

2. *Dung of Birds.*—This head refers to the dung of pigeons, domestic fowls, and sea-birds.

Pigeons' dung certainly possesses much fertilizing power. It readily ferments when moist; but is generally applied in as fresh a state as possible, in gardens, to onions, or to crops of wheat or barley in the fields, sometimes with a mixture of peat, in which case twenty bushels per acre are sufficient. The dung of domestic fowls is likewise carefully collected in the poultry-house or yard; it resembles pigeons' dung in its effects. But the most valuable article of this sort, is the dung of sea-birds that live upon fish. This substance is produced in such quantities upon some small islands in the South Sea, that fifty vessels are annually employed to bring it to fertilize the steril plains of Peru. It is there called *quano*. If the rains of our climate should injure this manure on the rocks and small isles on our coast, yet it may be found in great perfection, in caverns or clefts, resorted to by the cormorant and the gull; and in the West Indies it may be found on rocks, equal to that used in Peru†.

3. *Town Dung.*—This is an important article, yielding, in many cases, a considerable revenue to the towns, besides

beneficial. It is calculated that 1000 ordinary sheep, when folded, will manure an acre in a night. On the other hand, the profit of such folding is denied, and it is insisted on, that such a system, is pernicious to the sheep pasture, and injurious to the animals. To manure one hundred acres of arable in the vale, two or three hundred acres of pasture, are deprived of any benefit from manure, in the hills. The profit of the fold is reckoned only worth about 5*s.* per head per annum, and it is contended, the animal is injured by the practice, nearly as much, even with little driving. One advantage of folding, however, is, that the wildest sheep are rendered more docile, they feed better, and more quickly, during the time they are preparing for market.

* This plan is particularly described in the General Report of Scotland, vol. ii. p. 511, on the authority of Mr. Hunter, of Tynefield.

† Sir Humphry Davy's Lectures, p. 259.

fertilizing the neighbourhood*. In large towns, the quantity to be obtained is enormous, though it is to be lamented, that too much of it is thrown away and neglected. In London, it is estimated, that the annual produce may amount to 500,000 cart-loads, being only *a part* of the manure collected by sweeping 3000 acres of pavement in streets and market places, and the dung produced by 30,000 horses, 8000 cows, and now, including the environs, nearly a million of inhabitants†. The sweepings of streets is a species of manure, the effects of which are immediate, but not very durable. The dung produced by the cows and horses maintained in towns, if attention be paid to the preparation, is particularly valuable, as the animals by which it is produced, are generally maintained on food of the richest quality. That of horses being apt to become too dry, ought to be regularly removed, and mixed with other substances.

4. *Night Soil.*—This is the richest of all manures, and if dry, the cheapest‡. It is not only more quick in its operation than any other dressing, but supplies a great abundance of food for plants. Three or four cart-loads are sufficient to dress an acre for the first time, and afterwards, two loads per acre would keep it perpetually in heart§. It may be spread with peculiar advantage on grass lands after the hay is cleared away, in October. Its disagreeable smell may be destroyed, by mixing it with earth, sweepings of the streets, or quick-lime, or by making it into cakes, with one-third of its weight of rich marl, as practised in China‖.

5. *Urine.*—Every sort of urine contains the essential elements of vegetables in a state of solution¶. That of a horse,

* The city of Aberdeen, containing about 30,000 inhabitants, lets its dung for 1500*l.* per annum, or 1*s.* per head. At that low rate, the whole city of London ought to receive above 30,000*l.* per annum, for its street dung. *The street dung* alone of Edinburgh, was lately let for 2000*l.* per annum. In Derbyshire, particular attention is paid to town dung.—*Report*, vol. ii. p. 453.

† Middlesex Report, p. 301. ‡ Young's Essay on Manures, p. 168.

§ Middlesex Report, p. 301, note.

‖ Sir Humphry Davy's Lectures, p. 255. This manure is made into cakes, at Paris, under the name of *poudrets*, and is found of the utmost advantage, particularly on strong lands. Mr. Joseph Clarke of Goswell-street, prepares an article somewhat similar, in London. It appears highly probable, that much advantage might be derived from the addition of quick-lime, both by accelerating the desiccation, or by forming a chemical compound, as phosphate of lime, so important to the growth of wheat.

¶ Sir Humphry Davy's Lectures, p. 257. M. Cazeneuve, from Paris, by means of his "*mobiles inodores*," proposes to separate the urine from the night-soil, which would prevent the fœtid effluvium produced by fermentation. This would render the use of such manures, less objectionable.

Sinclair, Sir John. The Code of Agriculture; Including Observations on Gardens, Orchards, Woods, and Plantations. Third Edition, enriched by the Remarks, of a Number of the ablest Practical Farmers in England, Scotland and Ireland. Port. 8vo. lea. 594, 153pp. & plates. London, 1821.

3.00

being so much lighter, and less bulky, would be more valuable than its dung, if both must be conveyed to any great distance. The urine of six cows or horses, made in one year, will enrich a quantity of earth, sufficient to top-dress one English acre of grass land; and as it would require three pounds worth of dung to perform the same operation, the urine of a cow or horse, is worth about eight shillings and sixpence per annum, allowing 8*s.* per acre, as the expence of preparing the compost. Urine is much improved by powdered rape-cakes thrown into the cisterns where it is kept. The advantages of irrigating grass lands with cow urine, almost exceed belief. Mr. Harley, of Glasgow, (who keeps a large dairy in that town), by using it, cuts some small fields of grass, several times in a year, and the average of each cutting is fifteen inches in length*. As this article is of a scorching quality, it is unsafe to apply it to growing crops, in great heat or drought. Hence it is unadvisable to use it, except to grass, after the month of April or May, unless diluted. It is particularly useful in spring, when the application of liquid manure gives a new impetus to the plant, and makes its growth more vigorous†. This manure, forces newly planted cabbages in a most remarkable manner‡. This valuable article is too often suffered to flow away, without any attempt to collect it, either to throw it over the dung-hills, or for the purposes of irrigation§.

6. *Land Animal Substances.*—These form a numerous and valuable class of manures. In general, they require to be blended with earthy substances, that a too rapid decomposition may be prevented‖.

Much useful matter of this description is lost: for instance, if animals which have died of old age or disease, were covered with five or six times their bulk of soil, mixed with one part of lime, the earth would, in the space of a few months, be so impregnated with soluble matter, as to be rendered an excellent manure¶. Besides preventing a nuisance, the putrifying flesh would be more valuable to the farmer, than if sold for dog's meat.

Much manure is got, from the offals of butchers, and the

* Hints on the Agricultural State of the Netherlands, p. 63.

† If bones or sea-shells are properly sprinkled with putrid urine, it excites such a fermentation, as to dissolve them, and thus a manure is formed, much more valuable, and more speedily efficacious.

‡ Communication from John Middleton, Esq.

§ Curwen's Report, p. 61.

‖ Sir Humphry Davy's Lectures, p. 251.

¶ Ditto, p. 251.

blood and other substances that are collected in markets; the *graves*, or refuse of tallow-chandlers, are likewise excellent for turnip crops on the poorest soils. Every attention ought to be paid to the collection of these articles.

Bones, either broken in pieces by a mill, or the refuse turnings and dust of bone manufacturers, are used with much advantage as manures, and are peculiarly calculated for limestone land. They are an admirable dressing for turnips, and, when bones are used, it is said that the fly does not injure the crop; the produce equals in quantity that from dung, is supposed to be more nutritious, and the succeeding crops of barley and clover, are excellent. The expence is at the rate of 2*s*. per bushel, and sixty bushels are sufficient for a statute acre. A three-horse cart or waggon, will carry 300 bushels to a considerable distance. If eight cubic yards of ashes, and twenty tons of crushed bones, were employed per acre, the crop would be very great, as the ashes would promote the early growth of the plant, and the bones, being a more permanent manure, would operate when the ashes were exhausted. Women sow them in drills, and a person follows with a fork, to put them as even as possible in the furrow*.

Every species of animal offal or refuse will act as a manure; as, 1. *Woollen Rags*, chopped in small pieces, from 5 cwt. to 12 cwt. to be used per acre; they are best for dry, sandy, or chalky† soils, as they attract moisture from the atmosphere, and retain it. 2. *Curriers' shavings*, *furriers' clippings*, and *leather rags*, which are likewise calculated for dry soils; the quantity required is about thirty bushels per acre. 3. *Horn shavings*, equally applicable to all soils, worth about 1*s*. per bushel, 30 of which are sufficient per acre. 4. The *scrapings of sheep trotters*, *calves feet*, *&c. hog's hair*, *feathers*‡; in short, all sorts of animal substances should be collected, and, if ploughed in, will increase the fertility of the soil.

7. *Fish.*—Along such an extent of coast as Great Britain and Ireland possess, much advantage might certainly be derived from fish as manure. In the fens of Lincolnshire, Cambridgeshire, and Norfolk, the small fish called stickle-

* Communication from George Baker, Esq. Elmere, near Durham. The bones are to be had at Newcastle, (Tyne) and its neighbourhood.

† The effects of woollen and leather rags, on chalky soils, are said to be peculiarly striking.

‡ Ten bushels of old feathers, have added two quarters to the produce of an acre of wheat.—*Lincolnshire Report*, p. 143.

backs, periodically swarm in the rivers to such a degree, that they may be purchased at from 6*d.* to 8*d.* per bushel, and applied in forming composts. Herrings, sprats*, and the fish called sea-dogs, (after the oily parts are taken out), are managed in the same way. The refuse of the pilchard fishery in Cornwall, never fails to give great crops, wherever it is spread. Whale-blubber offal also, is every where applied to this use, and with the greatest success. Such manures, minutely divide the particles of the soil; and are peculiarly beneficial to newly broken up barren soils.

2. *Calcareous Manures.*

This important class of manures is more generally, and more correctly applied in this country, than in any other. It comprehends a number of articles, as, Burnt, or calcined limestone;—Pounded limestone;—Limestone gravel;—Chalk;—Marls;—Sea-shells;—Soapers' waste;—and Gypsum.

I.

Burnt, or *Calcined Limestone.*—Under this head may be considered, 1. The advantages of this manure; 2. Its disadvantages; 3. The principles on which the fertility produced by lime depends; 4. The several sorts of limestone; 5. The mode of preparing it for use; 6. The application; 7. The expence; 8. The effects; 9. The rules for its management; and, 10. Some remarks on the difference between *caustic* and *mild* lime.

1. *Advantages of Lime.*—Though there are exceptions to the rule, yet in general, it is confidently asserted, that unless where a soil has by nature, enough of calcareous matter in its composition, for the purposes of vegetation, it can neither be brought into its most fertile state, nor will other manures

* Sprats are frequently applied as manure to the hop-gardens along the borders of the river Medway in Kent; and they produce great effects, though only for one year.—*Communication from John Middleton, Esq.*—See Report of Cornwall, as to the effect of fish on grass lands. In the county of Galway, in Ireland, fish manure has been found highly advantageous. In Scotland, it is calculated, that fourteen barrels of herrings, will yield one barrel of refuse, or garbage, two barrels of which will be a single-horse cart-load. Sixteen load of this manure, the produce of 84 barrels of herrings, when mixed with 48 loads of earth, will manure an acre of land. If 300,000 barrels of herrings therefore, are caught in Scotland, in one year, the garbage would be sufficient to manure about 3600 acres of land per annum.—*Communication from William Young, Esq. of Inveruglie.*

be so useful as they ought, if lime, or some other calcareous earth, be not previously applied*. By lime spread upon a moory soil, either naturally dry, or properly drained, good herbage is produced, where nothing but heath, and unpalatable grasses grew before†. By the same means, pastures, instead of being ruined by fog, or yielding nothing but bent, and other inferior grasses, have been covered with those of a more valuable description‡. The utility of lime to turnips is so great, that though in the same field, where no lime had been applied, the crop died away; yet in the limed part, the turnips flourished with unabated vigour§. On the Mendip lands in Somerset, by the application of lime, the value of land was raised, from 4*s*. to 30*s*. per acre; and dung, which previous to liming, had no sensible effect, operated, after its application, as on other lands‖. Macclesfield Forest, in Cheshire, and vast tracts in the northern and more elevated parts of Derbyshire, and the adjacent districts, have been astonishingly improved by the same means¶. The rye lands of Herefordshire, in 1636, refused to produce wheat, pease, or vetches; but since the introduction of lime, they have been so fertilized, as to be successfully applied to the growth of every species of corn**. By the application of lime, a larger quantity of straw is produced, more dung is procured, and the crop is less liable to be lodged. Its utility in promoting the destruction of worms and other vermin in the ground, is well known. In newly cultivated soils of a tolerable quality, the richest manure will not enable them to bring any crops, but those of oats or rye, to maturity; whereas if they receive a sufficient quantity of lime, crops of pease, barley, or wheat, may be raised to advantage††. The benefit resulting from the use of lime, has been indisputably proved in the same farm, for the richer parts that were left unlimed, were uniformly inferior

* Northumberland Report, p. 134.

† Husbandry of Scotland, vol. i. p. 170. Even the cover of limestone quarries, has been usefully applied to heath, to rough stunted grass lands, and to meadow grounds.

‡ Westmoreland Report, p. 235.—Lime is supposed not to increase the quantity of grass, though it improves its quality. It certainly renders the herbage more nutritious, whether as hay or pasture, and preserves the stock, sheep in particular, from some disorders.

§ Northumberland Report, p. 131. ‖ Somerset Report, p. 512.

¶ Derbyshire Report, vol. ii. p. 38, 401, &c.

** Herefordshire Report, p. 57.

†† Husbandry of Scotland, vol. i. p. 170.

in produce, to the poorer that had been limed, during a period of not less than twenty-one years, under the same course of management*.

2. *Disadvantages of Lime as a Manure.*—It must not be imagined, however, that the application of lime, can always be made with profit. When either bestowed in too great a quantity at once, or too frequently repeated, it renders a soil sterile. It only operates advantageously, when it has a super-abundance of vegetable matter to act upon; and, on light soils, it is peculiarly hazardous to repeat it too often, except in compost†.

3. *The principles on which Lime operates as a Manure.*—Quick-lime in powder, or dissolved in water, is injurious to plants; hence grass, watered with lime-water, is destroyed. But lime freshly burnt, or slacked, forms a compost with vegetable matter, which is partly soluble in water, and nutritive to plants. When applied to land in a powdery state, lime tends to bring any hard animal or vegetable substance, into a more rapid state of decomposition‡. It also renders salts, and other matters not easily decomposed, miscible in water, thus promoting vegetation. If used in a hot, or caustic state, to strong and retentive soils, it will not only subdue their tenacity, but will communicate a certain degree of warmth to the ground. Light soils, from the application of lime, become adhesive, and more retentive of moisture§.

4. *The various sorts of Limestone.*—Sometimes limestone is almost perfectly pure, as is the case with marble, which frequently contains scarcely any other substance but calcareous matter. Several sorts of limestone, however, have mixtures of clay and sand, in various proportions, by which the efficacy of the manure, in proportion to the quantity of these substances, is considerably diminished. It is necessary, therefore, to analyze limestone, to ascertain the proportion of pure lime, before it is advisable to use so expensive an article in great quantities, more especially if it must be conveyed from a distance‖. Bituminous limestone makes

* Husbandry of Scotland, vol. i. p. 186.—Lime has been successfully employed in the south of Scotland, to destroy the texture of that moorish subsoil, which is so unfavourable to vegetation.

† Remark by Edward Burroughs, Esq.

‡ Sir Humphry Davy's Lectures, p. 276, 278.

§ Curwen's Report, p. 60.

‖ From inattention to this rule, much money has been uselessly expended, and many have been led to doubt the efficacy of lime, because they employed a sort of inferior quality.

good manure. But the magnesian is the species which requires the greatest attention. Limestone sometimes contains from 20.3 to 23.5 of magnesia, in which case it would be injurious to weak soils, from the peculiar qualities of the lime, to apply more than from 25 to 30 bushels per statute acre, though in rich soils, double that quantity may be used, and still more with peat, on which soil it would have a most powerful effect in producing fertility*.

5. *Mode of preparing it for Use.*—Limestone is burnt in kilns of various constructions, and with various sorts of manure, as coal, peat†, furze, or faggots. It is applied with advantage to soils recently reclaimed, in a caustic state; but is generally *slacked*, by throwing water upon the lumps, until they crack and swell, and fall down into a fine powder‡. This operation, when it is to be done, should not be delayed, for, if properly burnt, calcined lime is easily reduced into a fine powder, which may not be the case, if the slacking be postponed. If water cannot easily be obtained, the lumps may either be divided into small heaps, and covered with earth, by the moisture of which they are soon pulverized; or they may be made into large heaps, the lumps and earth in alternate strata, the lumps four inches, and the earth six inches thick, and the whole covered with earth. Where it can easily be had, it is a great advantage, to slack the calcined limestone for manure, with sea-water§.

6. *Application.*—Summer is the proper season for applying lime, for the land ought not only to be dry, but the surface as free from moisture as possible, so as to promote the equal distribution of the manure. That experienced farmer, Mr. Rennie of Phantassie, is of opinion, that the most profitable period for applying lime is, when the land is under summer fallow, in the months of June and July, that it may be completely mixed with the soil before the crop is sown. This is also the general practice in other

* Magnesian limestones are generally coloured brown, or a pale yellow. They are found in Yorkshire, (near Doncaster), in Somersetshire, and various parts of England; and near Belfast in Ireland. The application of this lime, would probably be the cheapest and most effectual mode of improving peaty soils. See Sir Humphry Davy's Lectures, p. 281; and Derbyshire Report, vol. ii. p. 409, &c.

† Nine-tenths of the lime used in Ireland, is burnt with peat. See Mr. Dutton's Letter, in the Farmer's Journal, Oct. 2, 1820.

‡ Slacked lime is merely a combination of lime, with one-third water.—*Sir Humphry Davy's Lectures*, p. 277.

§ Husbandry of Scotland, vol. i. p. 212.—Derbyshire Report, vol. ii. p. 438, to 445.

districts. For a turnip crop, it should be laid on in the spring, or early in summer, before the turnips are drilled; in order that the lime may be thoroughly incorporated with the soil, by the ploughings and harrowings it will receive*; the land will thus have time to cool, and the lime will not dry up the moisture necessary for bringing the turnips into leaf, or destroying the young plants. When applied to old ley, it is a good practice, to spread it on the surface, previously to the land being broken up, by which it is fixed firmly on the sward. One year has been found of use, but when done three years before, greater advantages have been produced; in the former case, the increase of oats being only at the rate of 6 to 1, and in the latter, that of 10 to 1, of the seed sown†. The quantity applied must vary according to the soil. From 240 to 300 bushels, of unslacked lime, may be applied on strong lands, with advantage. Even 600 bushels have been laid on at once on strong clays, with great success‡. On light soils, a much smaller quantity will answer, say from 150 to 200 bushels, but these small doses ought to be more frequently repeated. When applied on the surface of bogs or moors, the quantity used is very considerable, and, provided the land is naturally dry, or has been thoroughly drained, the more that is laid on, the greater the improvement§. The real quantity, however, of calcareous matter used, depends upon the quality of the stone. It often happens, that five chaldrons do not furnish more *effective manure* than three, because they do not contain three-fifths of calcareous matter‖.

7. *The Expence.*—So great is the variety, in regard to the

* The grubber, or scarifier, would answer this purpose effectually. No more should be spread at a time, than can be immediately mixed with the soil. It should not be spread in a windy day, for servants cannot judge so well of its equal distribution, nor perform it so well. But a gentle breeze is rather useful than otherwise.

† Communications to the Board of Agriculture, vol. iii. p. 231.—A previous application of two years, is in general considered to be sufficient.

‡ The late Mr. Barclay of Ury, often gave from 500 to 600 bushels of calcined lime per Scotch acre, or from 400 to 430 bushels per English acre; but when he gave such great quantities, he never limed a second time, except merely to give a slight top-dressing, when grass-seeds were sown.

§ Young's Essay on Manures, p. 322.

‖ A new mode of application, has lately been thought of in Cumberland. It is, after the first cutting of clover, to spread immediately on the ground, from 30 to 40 bushels of *hot lime*, per statute acre. This produces a great increase from the second cutting, greatly improves the value of the next year's grazing, and the succeeding crop of oats.—*Curwen's Report*, p. 24, and 42.

prices of lime at the kiln;—the cost attending its conveyance to the field;—and that of slacking, carting, and spreading it there;—and above all, in respect of the quantities necessary for different soils, in different circumstances, that no accurate statement can be given, of the expence of liming. On the whole, for unslacked lime, about 6*d.* per bushel, may be stated as an average price, all charges included; and from 120 to 300 bushels, as the quantity required, per statute acre. The following table, will then furnish some general idea of the probable expence:

Table of the Expence of Liming.

Quantity of Bushels of Unslacked Lime.	Expence of the Lime per Bushel.	Total Expence per Statute Acre.		
		£	s.	d.
120	6*d.*	3	0	0
150	Ditto.	3	15	0
200	Ditto.	5	0	0
250	Ditto.	6	5	0
300	Ditto.	7	10	0

8. *Effects of Lime.*—It is evident from the preceding table, that many farmers must subject themselves to an expence, of not less than ten shillings per acre per annum, for the lime they use, during the course of a rotation, and yet they are amply remunerated. The benefit derived in the cultivation of green crops, is sufficient for that purpose. Such crops may be raised by large quantities of dung; but where calcareous substances are applied, it is proved by long experience, that a less quantity of animal and vegetable manure will answer the purpose. This is making the farmyard dung go farther, with more powerful, and more permanent effects; for in consequence of the weightier crops thus raised, the quantity of manure on a farm, will be most materially augmented. Indeed, upon land in a proper state for calcareous application, (as old ley), lime is much superior to dung. Its effects continue for a longer period, while the crops produced, are of a superior quality, and less susceptible of injury from the excesses of drought and moisture. The ground likewise, more especially if it be of a strong nature, is much more easily wrought; and, in some instances,

the saving of labour alone, would be sufficient to induce a farmer to lime his land, were no greater benefit derived from the application, than the opportunity thereby gained, of working it in a more perfect manner*.

9. *Rules for the Management of Lime.*—1. It is necessary to ascertain, the quality of any soil to which lime is to be applied, and particularly, whether it has formerly been limed, and to what extent. In general, it may be observed, that strong loams and stubborn clays, require a full dose of lime to bring them into action, as such soils are capable of absorbing a great quantity of calcareous matter. Lighter soils, however, require less lime to stimulate them; and may be injured, by administering such a quantity, recently calcined, as would prove moderately beneficial to those of a heavy nature. 2. As the effects of lime greatly depend on its intimate admixture with the soil, it is expedient to have it in a powdered state before it is spread, and the drier, and the more perfectly powdered, the better. 3. Lime having a tendency, from its increased weight, by the water it imbibes, to sink in the soil, cannot be ploughed in with too shallow a furrow, or kept too near the surface. 4. Lime ought not to be applied a second time, to weak or poor soils, except at a considerable distance of time, or unless mixed with earth in compost. After a second application, the land should be immediately laid down to grass. In many soils, more especially when newly cultivated, calcareous earths will, in the course of years, so far disappear, as to require a renewal. This sooner or later takes place in all cases, but more rapidly in pastures than in arable land, the plough often bringing up the lime to the surface.

10. *Difference between Caustic and Mild Lime.*—This is a point that has not hitherto been sufficiently attended to, and yet, unless it is well understood, lime may often be misapplied. The following hints, extracted from a paper written by an intelligent Agriculturist†, will throw some light on this important enquiry.

Lime, when newly burnt, is of a caustic nature, and it often retains that quality *longer than is commonly imagined.*

* Husbandry of Scotland, vol. i. p. 184; General Report of Scotland, vol. ii. p. 586.

† The late Dr. Fenwick of Durham. It is a short Essay, entitled, "Reflections on Calcareous Manures," which the Doctor read to the Literary and Philosophical Society of Newcastle-upon-Tyne, and which was printed at their request, but has not been published.

If applied to dead, but undecayed vegetables, it shrivels them up, and destroys their organization; it may be used, therefore, with great advantage, for the destruction of weeds in fallows. It may be advantageously employed in all cases where there is a great abundance of vegetable matter; but where the soil is deficient in nutritious substances, mild lime ought to be preferred. Caustic lime is said to *exhaust* the land, because it hastens the putrefaction of the animal and vegetable matter in the soil, and thus a larger portion of them is applied to the growth of plants, in a given space of time, than would otherwise have been the case. In this manner, it first produces more luxuriant crops, and in the next place, it enables the farmer to continue his land in tillage, until it is more completely deprived of the principles of fertility, than could have been practicable, if the calcareous manure had not been laid upon. Caustic lime is of so burning a quality, that the dung of horses, dropped round a lime kiln, is so completely destroyed, by that which falls from the carts in filling, or the particles blown about by the wind, as to become absolutely useless. It is not fit, therefore, to be employed with dung when in that state. If quick-lime also, is used with a crop of potatoes, the sets are corroded by it, and the crop rendered curled and scabbed. When lime, in a caustic state, is applied to land, it is of service by destroying acidity; but it exhausts the soil, of the carbonic acid, or fixed air, which it contains. It is of great use in composts, (as shall be afterwards explained), but no dung should be mixed *with caustic lime.*

Mild lime, on the other hand, may often be applied with advantage, when caustic lime would be injurious; and more especially to lands exhausted by injudicious cropping, or weak, from a deficiency of manure.

In the neighbourhood of Grantham, the farmers desisted from the use of lime, because they found their lands had been exhausted by it; but the limestone being employed to repair the roads in the neighbourhood, the scrapings, which consisted of mild lime, were, with great advantage, applied to the same lands. Lime made of chalk, has often been condemned as exhausting; yet the same chalk, uncalcined, has been found beneficial. In Dumfries-shire, where mild or *effete* lime is used for potatoes, it makes the crop more productive, and greatly assists the dung; and where mild lime is used in compost, it is supposed that a portion of dung may, without loss, be mixed with the heap. The pounded

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Agric

Sinclair, Sir John. The Code of Agriculture; Including Observations on Gardens, Orchards, Woods, and Plantations. Third Edition, enriched by the Remarks, of a Number of the ablest Practical Farmers in England, Scotland and Ireland. Port. 8vo. lea. 594, 153pp. & plates. London, 1821.

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shells of oysters have lately been applied, as a manure, with much success*.

In order to render caustic lime perfectly mild, it is sometimes necessary to turn it over frequently, so as to have it completely saturated with fixed air, or carbonic acid, before it is applied†.

II.

Pounded Limestone.—This substance differs from calcined lime, in containing fixed air, or carbonic acid, and likewise as being insoluble in water. Machines were erected in Scotland, for pounding limestone, many years ago, but unfortunately, were destroyed, before the experiment had been fairly tried. There is evidence, that the attempt was attended with success so far as the experiment had gone‡. The practice might certainly be of use in districts where fuel is scarce. The scrapings or dust of roads, made with limestone, which is in fact pounded limestone, has been used with advantage as a manure, in Yorkshire, Gloucestershire, and other districts, and ought never to be neglected. The dust of marble, and the shiverings of limestone quarries, are also of use.

* At Holkham, oyster-shells are broken to pieces, either by passing them through oil-cake crushers, or repeatedly drawing a heavy iron roller over them, when spread upon a stone, or hard-burned brick on-edge floor. A mill for crushing bark, would answer the same purpose. Anno 1816, 40 bushels of this manure were drilled in the usual way, upon 27 inch ridges, slightly covered with earth, and the turnip-seed sown upon it. In the same field, turnips were sown, on ridges of the same size, manured with farm-yard dung, at the rate of 8 tons per acre. The turnips were a good crop on both pieces, no difference perceptible; the succeeding crop of barley, and the crop of clover afterwards, to all appearance, were equally good on both. Powdered shell manure was likewise tried, anno 1816 and 1817, in competition with powdered rape-cake, as a manure for wheat, partly drilled with the seed when sown, and partly applied in spring, drilled between the rows of wheat, and there was no perceptible difference in the produce, between the land manured with the shell-powder, or with the powdered rape-cake.

† A curious circumstance is mentioned by the same author, which he ingeniously accounts for. A quantity of very mild lime was laid in a heap, where it remained for some time, and when it was removed, the spot was covered with white clover. A heap of hot lime was left for the same space of time, no vegetation took place for a considerable period, and the spot was at length covered with couch-grass.—Neither the clover nor the couch-grass could be produced by the heaps of lime, but the circumstance is thus accounted for:—The hot lime retained its causticity much longer, and in that state, destroyed any seeds contained in the soil; but the couch-grass being less easily destroyed, or shooting and spreading from the neighbouring land, soon took possession of the vacant spot. In regard to the clover's following the mild lime, there is nothing singular, as its seed is very generally diffused, and always vegetates in a calcareous soil.

‡ Perthshire Report, p. 283.

III.

Limestone Gravel.—This excellent manure, (by some called *corn* gravel, from its productive qualities in arable soils), is peculiarly calculated for peat-bogs, the weight of the article giving a pressure that is much wanted. It has likewise been tried on sandy soils with success, when mixed with substances of a gluey or adhesive nature*. Its effects are equal in fertility, and more permanent than lime. It has been of immense benefit to Ireland, and may probably be found in many other parts of the United Kingdom, if diligently searched for. Its value was accidentally discovered, in a parish in Scotland, where it has since been used with the greatest success†.

IV.

Chalk.—This calcareous substance proves an useful manure in many of the southern and eastern districts of England, where it abounds. It is frequently applied in a crude state, spread upon the surface in autumn, and left to be dissolved by the winter's frost. From five to eight waggon loads per acre, are attended with beneficial effects. When calcined, from 100 to 200 bushels per acre are applied, but the effects not being lasting, the application requires to be repeated every four or five years. Calcined limestone, where it can be obtained, is much more effectual. Both chalk and marl are supposed to have the beneficial effects of all the calcareous earths, in giving stiffness and whiteness to straw‡, as well as rendering the skin of corn thin, and increasing the quantity of its meal§.

* Remark by Edward Burroughs, Esq.

† A ridge of irregular hillocks runs across the parish, which consist of large sand, or rather gravel. This gravel has of late been used with great success, as a manure for the land in the neighbourhood. Its excellency was discovered about twenty or twenty-five years ago, (that is, about the year 1770, the account being dated 1793). They use this gravel for repairing the highway between Aberdeen and Peterhead; and some years after, they were surprized to see fine white clover, growing very thick on those places of the road, which had been repaired with this gravel, and every other place as bare as ever. This induced them to try the gravel as a manure, which they continue to use, and find it uncommonly rich and durable.—*Statistical Account of Scotland, (Parish of Slains)*, vol. v. p. 280.

‡ Hence straw, for hats, and similar manufactures, is found in the greatest perfection in the neighbourhood of Dunstable, Luton, and other places in the Chiltern range of hills. It is probable, that the *silex* which the soil in these districts contains, produces this effect.

§ Communication from John Middleton, Esq.

V.

Marl.—Of this substance there are four sorts,—Rock;—Slate;—Clay;—and Shell-marl. The three former are of so heavy a nature, as to be seldom conveyed to any distance; though useful when found below a lighter soil, to which it can be applied without incurring much expence.

As in Lancashire and Cheshire, clay marl is the great source of fertilization, and neither labour nor expence prevents the most vigorous application of it; it may therefore be proper, to give a general view of the mode of using it, adopted in those districts.

The first object is, the disposition of the pits. These are made where the least land is thereby destroyed;—where they afford the least length of carriage;—where they occasion the least draught, by going down hill if possible;—where they will occasion the least damage to the lands in future;—and where, if that point can be obtained, it is practicable to lay them dry, when no longer necessary*.

The pits are worked by undermining, and loosening on each side large masses, and then by long piles driven in at the top, sometimes with the aid of water, forcing the mass down. This method is expeditious, but attended with danger to the workmen.

Marl is generally laid on grass lands, beginning the operation in May or June, and carrying it on during the summer: the older the sward the better. The union of the marl and grass, causes a fermentation and putrefaction, which seems necessary to produce a full effect.

The quantity of clay or red marl used, is enormous; in many cases about 300 middling cart-loads per acre, and the fields are sometimes so thickly covered, as to have the appearance of a red-soiled fallow, fresh ploughed. In some cases, slighter coverings are preferred, and the process is more frequently repeated.

Marl, after carting, is left on the ground in a rough lumpy form, that it may be exposed as much as possible to the influence of the weather. It should partake of one summer's sun, and of one winter's frost, by which it is reduced into the form of an unctuous, but friable material, the further dispersion of which, is easily effected by clodding beetles, or mallets, spades and harrows. It is thus equally distributed over every part of the surface, and afterwards ploughed in;

* On the other hand, many valuable pits of water have been obtained, by taking out clay-marl for the sandy lands in Norfolk.

and the effects are represented to be in the highest degree beneficial*.

In regard to shell-marl, it consists chiefly of calcareous matter, the broken, and partially decayed shells of fresh-water fish, found at the bottom of lakes or ponds, filled up with mud. It may be applied as a top-dressing to wheat and other crops, when it would be hazardous to use quick-lime. In the counties of Selkirk, Forfar, Ross, Caithness, and in other districts, shell-marl has been of great value in fertilizing the soil—though from its stimulating powers, the land has been often injured, by employing it in too great quantities, and over cropping.

VI.

Sea Shells.—This manure abounds in various parts of the British Isles. It is superior to the usual sorts of limestone in purity, and in the proportion of calcareous matter it contains. It likewise often contains a small portion of animal matter. These shells have not, however, unless when burnt, the same rapid and powerful influence on the soil. When not burnt, they are much improved in their effects, if broken by a mill resembling that used for tanners' bark, to give the air a readier access to promote their decomposition, and to enable them to be more equally distributed. Where straw is scarce, they are used as a substitute for litter: and the urine greatly contributes to the shells being reduced.

Sea-sand, with a mixture of shells, is used with much success as a manure, on the coasts of the North and East Riding of Yorkshire†; in Devonshire, and Cornwall‡, in

* See Marshall's Review of the Northern Departments, p. 287, &c, where the information contained in the Lancashire Report upon this subject, is very ably analyzed. In many parts of Derbyshire and Cheshire, there are the vestiges of ancient marl pits, though the practice of marling is now almost forgotten by the inhabitants.—*Derbyshire Report*, vol. i. p. 148, 456; and vol. ii. p. 407.—Surface-draining, properly conducted, might restore to these lands, their former capability of profiting from the treasure of red marl existing below them. As burnt clay is attended with such beneficial effects, burning rock, slate, or clay marl, would be still more beneficial, and it has been partially tried in Lancashire.

† North Riding Report, p. 238; East Riding Report, p. 55.

‡ This substance is much used on the coast of Devonshire and Cornwall. Near Falmouth, 50 in 100 parts of the article consists of broken coral; but in Cornwall, from 70 to 80 parts in 100 consist of broken shells. The farmers prefer taking it, as near low-water mark as possible. They thus obtain a small quantity of saline matter, (perhaps from 3 to 4 or 5 lbs.), but the advantages of this calcareous substance as a manure are, that it thickens, or deepens the staple of the soil;—that some parts of the calcareous matter,

Caithness, and on the coast of Buchan in Aberdeenshire. It is particularly useful in strong clays, as both its component parts, sand and shells, are beneficial mixtures in a clay soil.

VII.

Soapers' Waste.—This is said to be a useful manure of a calcareous nature, with an inconsiderable mixture of other substances. It is best calculated for grass lands, to the beneficial effects on which, the gypsum and saline substances it contains, probably contribute. It is likewise of use to peaty soils, and is excellent for gardens, from its destructive effects on insects. The average quantity used is about 100 bushels per statute acre, but greater quantities have been applied with success. It is advantageously employed in compost. Autumn is the best season for applying this manure to grass lands. For arable lands, the quantity should be greater than for grass lands, and greater on strong soils, and on peat, than upon light loams, and least of all, on dry soils and gravels*.

VIII.

Gypsum.—This substance consists of sulphuric acid and lime, and its application to crops of cultivated grasses, in such moderate quantities, as five or six bushels per acre, is often attended with great effects. The ashes of sainfoin, clover, and lucerne, when these plants are calcined, afford that substance in considerable quantities; and thence there is reason to believe, that it is a necessary part of the woody fibre of these, as well as a component part in most of the other grasses. Cultivated soils in general, contain it in sufficient quantities for the grasses they produce; but where there is any deficiency, fields, which have ceased to bear good crops of clover, and other artificial grasses, may perhaps be restored to their former fertility, by the use of gypsum†.

where it is required, enter into the composition of the plant;—that is loosens the earth, and rendering the soil more friable, enables the plant to take a greater range in quest of food;—and that being an absorbent of acids, it is a corrector of the soil. *Communication from the Rev. Robert Hoblyn.*—In the parish of Southend, in Argyllshire, there is a bank of fine coral, about 100 yards from the sea-mark. It is superior to lime for moist heavy lands, and is of signal service to gardens, and to pasture and heath lands.—*Statistical Account of Scotland*, vol. iii. p. 367.

* It is certain, that in several cases soapers' waste has been found of use; but it is said to have been extensively tried in Surrey and Kent, upon both old meadows, and arable land, of the stronger kind, without its producing any beneficial effect. Perhaps it was applied in too small quantities.

† Sir Humphry Davy's Lectures, p. 287. The indifferent success which has attended the trials of gypsum in Derbyshire, where this substance is dug

In lands full of calcareous matter, the celebrated Ingenhouz, strongly recommended sprinkling on the soil sulphuric acid, so as to make an *artificial gypsum.* This, he contended, would be a likely means of benefiting the crops of clover, and other valuable grasses, and might be useful even to crops of corn. The plan is well worth a trial, where calcareous earths too much abound.

3. *Earthy Manures.*

Under this head may be classed, vegetable mould or loam, peat-earth, clay or sand, burnt clay, sea-ooze or warp, canal, pond, or river-mud, and road-scrapings.

1. *Mould,* or *Loam.*—In many cases, as in forming roads, making canals, erecting new houses, &c. considerable quantities of excellent mould or loam are dug up, which, not being required for any purpose on the spot, are removed, and applied, either in making compost dunghills, or in augmenting the staple of land, where there is any deficiency of depth.

2. *Peat Earth.*—It is found that the dust of dried rotten peat is, in some soils, an excellent manure for potatoes. The peat is cut in pieces, as if intended for fuel, and after being exposed to the atmosphere for some time, it is laid upon the land*. Peat earth, called *bog-stuff* in Ireland, when applied to light and gravelly soils, produces excellent crops, more especially if mixed with a small portion of lime or clay†.

3. *Clay,* or *Sand.*—The plan of improving the texture of a soil, by conveying clay, where sand predominates, and the reverse, has been already alluded to, in Chap. I. Sect. 2, and has been attended with great advantage. Clay can hardly fail to be useful to sand; but it has been justly observed, that many soils acquire the name of clays, because they are cohesive for want of effective draining, which, when examined, are found to be *sandy loams,* and consequently

in large quantities, may be owing to its being burnt. Mr. Farey therefore, recommends trying it ground, or in powder, as practised in America, and on the Continent of Europe. *Derbyshire Report,* vol. ii. p. 448.—This substance unburnt, was tried at Holkham, in 1819, on the recommendation of Mr. Holdich, for clover and sainfoin. Six bushels of the powder were used per acre, with prodigious effect.

* Argyllshire Report, p. 221, 222.

† Second Report from the Committee on the State of Disease in Ireland. Printed by the House of Commons, 7th June, 1819. Appendix, p. 139.

‡ Young's Essay on Manures, p. 126.

have no occasion for any additional quantity of sand*. In Cheshire, sand is frequently used as manure on stiff lands, with great success†.

4. *Burnt Clay.*—It is well known, that burning clay is an old practice, which, at various periods, has been pursued with energy and success, and at other times has fallen into neglect. The oldest book in England in which it is mentioned, is, "*The Country Gentleman's Companion,*" by Stephen Switzer, gardener; printed in London, in one volume octavo, an. 1732‡. In that work it is stated, that the Earl of Halifax was the inventor of this useful mode of improvement; and that it was much practised in Sussex. There are engravings of two kilns for burning clay, one adopted in England, and the other in Scotland, where it is said to have been ascertained, that lands, reduced by tillage to poverty, would produce an excellent crop of *turnips*, if the ground were ploughed two or three times, and clay ashes spread over it. In the same work, there are several letters written in the year 1730-1, which mention, that the plan of burning clay had succeeded in several parts of England; and accounts were received from Scotland, which stated, that it had answered better than either lime or dung, but was found too expensive. In 1786, Mr. James Arbuthnot, of Peterhead, tried several successful experiments with burning clay, so that though lately revived, the practice is not a new one. From the energy, however, with which it is now taken up, it is to be hoped, that new experiments, on the different modes of burning clay, both to simplify the process, and to reduce the expence, will be tried, which will lead to a more extensive use of this article as a manure§.

An intelligent correspondent maintains, that burnt clay deserves to be ranked among the most valuable manures, not only from the facility with which it is obtained, but from its being suited to soils in general, and to crops of every description‖. This is accounted for, by its contain-

* Young's Essay on Manures, p. 126.

† Cheshire Report, p. 22.

‡ In the Select Transactions of the Society of Improvers in Scotland, from 1725 to 1742, it is particularly described, and strongly recommended.

§ In a Letter published in the Farmer's Journal of the 13th Dec. 1819, signed John Day, the use of *clay ashes* is much recommended, as calculated, at some future period, to double the value of all the strong clay soils in the United Kingdom, by changing them from a tenacious clay, to a friable garden mould.

‖ Remark by Edward Burroughs, Esq.

ing oxyde of iron, which is favourable to vegetation. It is said, that more than one half of the potatoes raised in Ireland, more especially in the western parts of that country, are produced from that manure*.

5. *Sea-ooze*, or *Warp*.—This substance abounds at the mouths of friths, estuaries, or arms of the sea, and of the rivers which run into them. It is of a most enriching nature, and adds to the staple of the soil. It is used as a top-dressing in spring, for crops both of grain and grass, more especially for the latter. It is an excellent material for composts, particularly for thin soils. The late public spirited Duke of Bridgewater, between the years 1790 and 1800, made considerable use of sea-ooze, brought up from the Mersey, in barges, by his canal, to lands near Worsley. It promotes the improvement of garden soils in a manner hardly to be credited; and wheat or oats, manured with sea-ooze, is little subject to rust, mildew, or any other disorder†.

6. *Canal, Pond, or River Mud*.—This article is not of equal use in every instance, as much of its quality depends upon the substances with which it is mixed. Where the water is resorted to by cattle, or water-fowl, or receives the washings of towns, houses, farm-yards, &c. or the immediate drainage of large tracts‡, it is richer, and will prove valuable, in whatever way it is managed§. It must at any rate add to the staple of the soil with which it is mixed, and bring with it some useful ingredients. In the Netherlands, it is found by the gardeners of Ghent, that the mud of canals and rivers, is much improved in its quality, when it is exposed, in small heaps, to a winter's frost, and a summer's sun, before it is used. This proves how much the success of agriculture depends upon *minutiæ*. For the same substance, which, if mixed with the soil, immediately after being taken up, might be of little or no use, may, when properly prepared, be highly conducive to fertility.

7. *Road Scrapings*.—The mud raked and shovelled from the public roads, may, with great advantage, be used as an

* See Mr. Dutton's Letter, in the Farmer's Journal, Oct. 2, 1820.

† General Report of Scotland, vol. ii. p. 530. This may arise from its being so strongly impregnated with saline matters. It is desirable, however, to have the mud applied as manure, fermented with dung, to destroy all vegetative powers in the roots, or in the seeds of weeds, which the mud might contain.

‡ As tracts of wood. Derbyshire Report, vol. iii. p. 187, 448.

§ Young's Essay on Manures, p. 160.

ingredient for forming composts, particularly for clay soils. Where the stones, of which the roads were made, consist of limestone, such a compost is singularly useful. In particular instances, it is even more economical, to purchase road scrapings, than town-dung, on account of the carriage*. Indeed the impalpable dust of limestone roads, if collected and kept dry, until spread on the land, would answer as well, if not perhaps better, than mere lime, owing to the dung of horses, &c. mixed with it†.

4. *Vegetable Manures.*

Manures from the vegetable kingdom, comprehend the following articles: Sea-weeds;—Fresh-water weeds;—Common weeds;—Malt-dust;—Rape-cake;—Tanners' bark;—Vegetables ploughed in;—Vegetables that have passed through fire;—Water in which vegetables have been immersed;—and, Dry vegetable substances.

1. *Sea-weeds.*—In many districts, this is a most important source of fertility, and when used with judgment, never fails to enrich the coast lands of every district when it can be had, whether cut from the rocks, or thrown ashore. Its effects, however, are by no means so lasting as those of farm-yard dung, enduring only for one or two crops.

Sea-weed applied to arable land, cannot be spread and ploughed in too soon after it is secured. If that cannot be accomplished, from the season of the year, or otherwise, it should be made into a compost with earth, or long dung, or lime‡. Tangle, or drifted sea-ware, if spread on old grazing pastures, not only improves the quantity, but the quality of the herbage; hence both cattle and sheep eat it with avidity, thrive well, and are made sooner fat. It is not so well calculated as dung for oats, or for a crop of turnips; but it answers exceedingly well for barley. If applied to the tender blades of young clovers after harvest,

* General Report of Scotland, vol. ii. p. 544. Derbyshire Report, vol. ii. p. 445.

† Communication from Mr. Farey.

‡ The late Duke of Richmond, found lime and sea-weed a most excellent compost. He mixed six waggon-loads of sea-weed, with one load of lime shells, in a heap 18 feet long, and 10 feet wide, in the beginning of August, and in the September following, the compost was carried to the land, turned over three times, and used as a top-dressing in October, when the wheat was sown. The crop exceeded five quarters per acre. The compost had the appearance of earth and lime mixed together, with some streaks of white, which were very salt. The bulk was reduced one-third.

it will destroy the plant*. It may be advantageously mixed with farm-yard dung, for the purpose of rotting the dry parts of its contents. It requires one-third more by weight per acre, than farm-yard dung.

Sea-ware has several advantages above other sorts of manure. It is not filled with seeds of weeds;—it readily decomposes;—does not require a long process of preparation; and is directly useful to the plant. With its aid, the farmer is enabled to take more frequently crops of grain, or green fallow crops, and thus increases his farm-yard manure. Its good effects cannot be disputed, and nothing can be objected to its use, but an idea, that the grain it produces is of an inferior quality.

2. *Fresh-water Weeds.*—These substances are frequently found in lakes, ponds, and rivers; and being replete with vegetable food, merit the particular attention of those, who have such useful articles at their command. They may be carried into the farm-yard, to increase the heap; or made into a compost with earth; or ploughed into the ground for barley; or used in drills for turnips; or reduced into a nutritive mass, by a mixture with hot lime.

3. *Common Weeds.*—It has been found, that an excellent compost can be prepared, by collecting all sorts of weeds, as thistles, docks, nettles, fern, &c. before they have formed seed, and laying them up with alternate layers of rich earth. A great heat is soon raised, and by turning the heap over next spring, the whole will be resolved into a soft pulpy mass, the effects of which on the soil, are in no degree inferior to dung. Thus a great nuisance may be converted into a valuable manure†. Where lime is abundant, it should be mixed in its caustic state, with green or succulent weeds; and as the moisture which they contain, will slack the lime, a considerable degree of heat will be created, by which the weeds will be speedily reduced‡. When the weeds are in a dry and withered state, they are not so easily formed into a putrescent mass.

4. *Malt-Dust.*—In some districts this substance is employed, as a valuable article for feeding milch cows, or pigs; in others, it is used as a manure, and found to be highly fertilizing. From 40 to 60 bushels are applied to an acre,

* General Report of Scotland, vol. ii. p. 528. Beans and pease thrive well, in a dry season, with ware as a manure; and it is used in East Lothian for a potatoe crop, with decided benefit.

† Forfarshire Report, p. 416.

‡ Roxburghshire Report, p. 142.

either for wheat or barley. It likewise greatly improves cold grass-land*.

5. *Rape-Cake.*—This species of manure, has long been used in various parts of England, particularly in Yorkshire and Norfolk. Half a ton per acre was formerly given; but the quantity, since the price of the article has increased, is now reduced to one ton for three acres; and Mr. Coke of Holkham, makes a ton to answer for five or six acres, by breaking it into small pieces, and ploughing it in, about six weeks before the seed earth, that it may have time to dissolve in the ground. It is a still more economical and beneficial practice, to sow the pulverized manure with the seed, for which an ingenious machine has been invented. Mr. Curwen has likewise ascertained, that five hundred weight of rape-cake, with two tons of dung, will manure an acre for turnips, *and produce an admirable crop.* The rape-cake only cost 2*l.*, and consequently this mode of manuring, is not only cheap, but from its inconsiderable weight and bulk, is peculiarly calculated for the more distant parts of a farm†.

It has been found in Flanders, that powdered rape-cake, strewed over the surface of the ground, destroys the *gryllo talpa,* so injurious in wet soils; and every insect of the same species, may be destroyed by the same means.

Such is the quantity of this manure used in the Netherlands, that a farmer, who only cultivates 75 English acres, purchases at the rate of 5000 rape-cakes, and 3300 cakes from poppy-seed, for manure, which cost him nearly 60*l.* per annum‡.

6. *Tanners' Bark.*—Mere woody fibre, like tanners' bark, requires fermentation to render it nutritive to plants§. It is sometimes mixed with lime, but a compost with dung, is more likely to be useful in rendering this substance fertilizing.

7. *Vegetables Ploughed in.*—The propriety of this system is much disputed. It was practised by the ancients, and is still said to answer well in warm climates; and in the warm seasons of cold climates. Several successful experi-

* Young's Essay on Manures, p. 182.—In Herefordshire, the pulp of pears and apples, after the liquor is extracted from them, mixed with quicklime, and turned over two or three times the succeeding summer, is converted into a good manure.—*Report*, p. 88.

† Curwen's Report, p. 66.

‡ Hints on the Agricultural State of the Netherlands, p. 12.

§ Sir Humphry Davy's Lectures, p. 247.

ments with ploughing in vetches,—the tops of turnips,—and the stalks of potatoes,—have been detailed by an intelligent agriculturist in Ireland*. But after being tried for several years in Lincolnshire, with buck-wheat, it was ultimately given up as doing no good†; and the general opinion is, that more benefit is derived from green crops, when consumed by stock, and converted into dung, than when ploughed in, without any mixture of that animal matter with which dung is necessarily impregnated‡. *The profit derived from feeding the live stock, on the green food, ought likewise to be considered.*

8. *Burnt Vegetables.*—These are of various sorts, as wood-ashes,—peat-ashes,—kelp, or the ashes of sea-weed,—and burnt straw.

Wood-ashes are certainly a valuable manure, and are peculiarly well calculated for gravelly soils and loams; forty bushels per acre is the common quantity, and spring is the proper season for their application: if rain succeeds, the effect may be relied on§.

The ashes of peat are a common manure, wherever that substance is used as fuel; but they are frequently of little value. There are two sorts of peat, however, one to be found in its greatest perfection, near Newbury in Berkshire, and the other in some provinces in Holland, the application of which is attended with astonishing results.

In some soils, particularly chalk, the Berkshire ashes may be of use, by supplying the oxide of iron, an article without which no soil can be productive, and of which chalky soils are extremely deficient. In others, the gypsum which such ashes contain, may promote fertility. Whatever passes through fire, also, does possess some valuable properties.

In Holland, they have two kinds of peat; one which is found on rising grounds, burns quickly and cheerfully, gives a good heat, and leaves only light ashes of very little value. The other sort is found in marshes, which are constantly covered during the winter season, with water of a *brackish* nature. This peat leaves a much heavier ash, frequently so full of saline matter, that it is sometimes used as a substi-

* In the Appendix, some interesting experiments on this subject will be detailed, from the Communications of Edward Burroughs, Esq.

† Lincolnshire Report, p. 265. Perhaps vetches, rape, or clover, would have answered better than buck-wheat.

‡ The practice of ploughing in, is strongly objected to by Lord Kames. —*Gentleman Farmer*, p. 358.

§ Young's Essay on Manures, p. 176.

tute for soda, in the manufacture of green glass. These ashes, are conveyed by the canals, in barges, into the interior of Flanders; and after they have reached Brussels, they are sent by land, from 50 to even 100 miles into the interior. The effects of these ashes are hardly to be credited. They are sown upon young clover in spring, and ensure two good crops of clover that year, and an abundant crop of wheat, unmolested by the wire-worm, next year. If it be the wish of the farmer to have clover for two years in succession, it may be obtained by the aid of these ashes. They are in general carefully sown by the hand, like grain, in a still, hazy morning. They are good for hops, and a handful should be spread on the surface of each hill, on which the hop vines are planted, to destroy the worms that infest them*. In various parts of England, Scotland, and Ireland, peat, producing similar ashes, may be met with; but experiments on a great scale, with the real Dutch ashes, ought first to be tried, to ascertain their efficacy in this country.

Peat-ashes, burnt in the Berkshire mode, are an excellent manure for turnips. If as many ashes are strewed in the furrow of a drill, as are sufficient to cover the surface, the crop will be abundant, and if the turnips are afterwards eaten off by sheep, the land, in the opinion of some, will be as much enriched, as if the turnips were produced by farm-yard manure.

Kelp, or the ashes of sea-weeds, has likewise been tried as a manure in Yorkshire, and has succeeded on grass lands.

The ashes of coleseed straw, or haulm, and of common straw, or stubble, have been made use of for turnips and other crops, with success. Indeed it is now ascertained, that the burning of straw, stubble, or any other combustible material, on the surface of the ground, after it is prepared for turnips, but before the seed is sown, is the most effectual mode hitherto suggested, of destroying the fly, and preserving the crop from their attacks. In France, more especially near Angers, and in Brittany, bushes are burnt, with advantage to the succeeding crop†.

9. *Water in which Vegetables have been immersed.*—It is well known, that the grass land on which flax or hemp is

* Hints on the Agricultural State of the Netherlands, p. 34. These ashes, when analyzed, are said to yield 12½ per cent. of gypsum, which sufficiently accounts for producing such effects on the clover crops.

† Communication from J. Attersoll, Esq.

put to be dried, after they have undergone the process of watering, is greatly improved, from the putrid fertilizing substances which they furnish. This furnished a hint to an intelligent agriculturist, (John Billingsley, Esq.) to try the effects of flax water, by the use of which he advanced the value of the land to which it was applied, to the amount of 10*s*. per acre.

10. *Dry Vegetable Substances.*—It has been found in Dumfries-shire, that the husks or shells of oats, form an excellent manure; fresh vegetable matter, as saw-dust, when simply reduced by mechanical division, is of use by itself; but is much improved, by a mixture with other substances, as the refuse of butchers' markets, urine, &c.

5. *Miscellaneous Articles of Manure.*

This head contains, Salt;—Soot;—Refuse of various manufactures;—Refuse of coal-mines;—Refuse of lime-kilns;—and the mode of applying manures, by scattering them over the surface, or top-dressing it.

1. *Salt.*—The utility of salt as a manure, and for other agricultural purposes, is a subject of such great importance and extent, that it will require a separate discussion.—(See Appendix, No. IX.) There are three particulars, however, connected with the subject of salt as a manure, which it may be proper here to mention.

1. In a series of experiments tried by the Rev. Dr. Cartwright, he found a mixture of salt and soot, in moderate quantities, preferable to any other sort of manure*; a circumstance which might be attended with considerable advantages to farmers in the vicinity of large towns.

2. It has been ascertained in America, and confirmed by the experiments of Mr. Lee of Enfield-Wash, near London, that salt is an excellent manure for flax. The quantity of salt should be double that of the seed used, and should be sown at the same time. It is probable, that all oily seeds should be treated in the same manner.

3. But the most important circumstance, respecting the beneficial effects of salt, when employed as a manure, is the probability that it will prevent the rust in wheat. That

* Communications to the Board of Agriculture, vol. iv. p. 370.—In large quantities, soot and salt are of so acrid a nature, that no species of grain will grow within the sphere of the full exertion of their powers.—*Remark by the Rev. Robert Hoblyn.*

might justly be pronounced, the greatest agricultural discovery of modern times, if it were found in all cases effectual.

2. *Soot.*—This is an excellent manure, but it can only be procured, in large quantities, in the neighbourhood of great towns. It contains substances highly favourable to vegetation; for the effects of soot, when spread upon the surface, are discovered immediately after the first rain. It is likewise of use, from the saline matter it contains, in promoting the destruction of slugs. When applied in its natural state, as a top-dressing for clover, or young wheat, about twenty bushels per acre, is the usual quantity; but it is frequently mixed with other articles. The most approved composition is, one part soot, five parts earth, and one part lime*. The earth and soot should be well mixed before the lime is applied. It should remain in that state five or six weeks, then be turned over again, and thoroughly incorporated, before it is sown on the ground†.

3. *Refuse of Manufactures.*—Much excellent manure is collected at various manufactories, where mineral acids are not used. Soap-suds, lees, and other impurities, which are taken from the boilers, should be mixed with ashes, straw, turf, peat, or any other substance that would absorb the moisture. Thus, what tends to render the water of streams or rivers, into which these articles are at present too frequently thrown, impure and unwholesome, would enrich the land‡.

4. *Refuse of Coal-Mines.*—In the neighbourhood of coal-mines, much advantage might be derived from their refuse, which, at present, is not only lost, but is actually an incumbrance, covering much ground that might be rendered fertile. In many cases, these hills of coal rubbish ought to be reduced to ashes, which might be applied to grass lands with

* Mr. Middleton is of opinion, that this compost would occasion unnecessary expence, and recommends the following plan as preferable: sow the soot upon the land, and harrow it in; there it will have a sufficient quantity of earth; and some time afterwards, lime the same soil, and harrow that in. The effect will be the same, as would be produced by the proposed compost, and the benefit would be obtained at much less expence.

† General Report of Scotland, vol. ii. p. 543. The truth is, that any addition to soot, and making it into compost, can only be, for the purpose of more certain distribution, and to prevent waste by blowing. To save that expence, soot may be sown unmixed, in rainy weather, over the crop when young.

‡ Renfrewshire Report, p. 135.

infinite advantage. Some kinds of schistus,—shale, or blaes, mixed with slacked lime, in the proportion of one-third, has been found an excellent manure for wheat and other crops*.

5. *Refuse of Lime-Kilns.*—Mr. Monteath, of Closeburn in Dumfries-shire, places a grate at the bottom of his lime-kilns, (which is of great benefit, by increasing the draught of air through the kilns); and he thus acquires many hundred cart-loads of refuse, consisting of coal-ashes, mixed with small pieces of lime, which would have been of little value, had the ashes been mixed and measured with the large pieces of burnt lime. He has employed this refuse, mixed with earth, to great advantage, in top-dressing peat meadows, and grass lands of every description. In many districts, immense heaps of this refuse are left totally neglected, except by a few public-spirited individuals†.

Nothing can be more desirable, than to bring into action, these sources of fertility, which are generally left unheeded. They not only produce immediate profit, but they increase and improve the staple of the soil; and indirectly, are the means of augmenting those putrescent substances, so essential to vegetation.

6. *Mode of Application by Top-dressing.*—These miscellaneous manures, and others distinguished by the smallness of their bulk, as rape-cake, malt-dust, &c. are generally scattered over the surface of the soil, and used as *top-dressings*. It has been said, that one-third part of the nourishment procured by dung and tillage, given in this mode to grain, and other plants, at proper seasons, proportioned to the different stages of their growth, would be more beneficial to crops, than the whole applied at the time of sowing‡. In light soils, manure is apt to be washed down; hence the advantage of using top-dressings, either at the time that the seed is sown, or shortly after it. Wheat, and other grains, obtain the principal part of their nourishment, from the roots which go some depth into the soil; but another set of roots shoot out in spring, which receive much benefit by top-dressings at that season, for the rains wash it in; and it is absorbed by these roots. Top-dressings are of little use in

* Mr. Curwen, of Workington-hall, manures 20 acres per annum, with this neglected rubbish.

† Derbyshire Report, vol. ii. p. 414.

‡ Sir John Anstruther's Remarks on the Drill Husbandry, p. 91.

improving the texture of the soil, and seldom do good for more than one or two seasons; but in many cases, the success of the crop has depended upon their being applied*.

6. *Composts.*

The subject of composts, the utility of which has been proved in numberless instances, may be considered under the following heads: 1. The materials used; 2. The soils or crops to which composts should be applied; and, 3. The effects produced.

1. *Materials.*—Unslacked lime, and earth of different sorts, are the substances commonly used. Quick-lime is the proper stimulus for bringing the powers of a compost into action; operating upon a heap of earth in some degree as yeast does upon a quantity of flour or meal. Enough ought to be applied, to excite a species of fermentation in the heap, and to neutralize or decompose, any pernicious mineral substances which may exist in it†.

The preparation and conveyance of compost, being attended with much expence, where circumstances will admit

* In the Farmer's Journal, Mr. Joshua Wigfull, sen. has inserted an account of the following experiment in top-dressing wheat. A Quaker near Sheffield, had a crop of growing wheat, which, during winter, seemed in an exhausted state, and to require support. In the month of March, he gave it a top-dressing of the following mixture, by hand: 21 lbs. of common nitre, reduced to powder, (value less than 10*s.*), well mixed with three bushels of good earth per acre, having previously made a trial of the efficacy of the mixture on quick growing vegetables in his hot-house and gardens. It is most surprizing the beneficial effects it has had on the wheat. On good land, more than 45 bushels per acre of wheat, have been produced, where the crop made a much inferior appearance before harvest. In fact, few pieces of wheat can look better, or be more promising than it does as present. A common farmer has made a trial of the mixture, sown upon some of his spring crops, when two or three inches high, with the same promising beneficial effects. Mr. Wigfull conceives, that on failing crops, or any part of a field that is so, the mixture will be found, where properly made use of, of incalculable value to the agriculturist and the public. His letter is dated July 26, 1820, and has since been confirmed in a communication to the author.

† The following experiment, by which a considerable extent of waste land was improved by Mr. Bruce of Grange-muir, in Fife, North Britain, by a compound of moss and lime, merits particular notice.—He mixed 1200 tons of peat, more than half dry, with 280 tons of lime. The mixture stood seven weeks. The temperature rose from 56 to 87. It was then turned over, and stood three weeks longer. It was applied, *anno* 1808, to 32 Scotch (about 38 English) acres. The first crop was wheat, ten Lothian bolls, or 32 Winchester bushels per Scotch acre. Rye-grass and clover, sown with the wheat, produced a heavy crop, followed by an excellent crop of oats. The land has ever since been in good order. The soil was partly clayey, and partly loamy, was never before cultivated. It was first fallowed, drained, and cleared of stones. The compost was applied before the last ploughing for wheat.

of it, horses, instead of manual labour, ought to be employed in the several processes, and the compost should, if possible, be prepared in the field, to which it is afterwards to be applied.

It has been ascertained by a number of experiments, that two bushels of unslacked lime, are sufficient for each cubic yard of earth of a medium quality, and as 80 cubic yards of loose earth, are sufficient to manure an acre, 160 bushels of unslacked lime is the quantity required, in an average of cases, to bring forward the process of fermentation. To obtain this quantity of earth, it is the practice of many farmers, to plough the head-ridges at both ends of the field, ten inches deep, and this can often be spared, without any loss, as these ridges are generally too high, in consequence of the earth accumulated in the course of years, from the plough being cleared every time it turns. This affords an easy mode of manuring a field with compost.

Composts are frequently made, not only of earth and lime, or dung, but of various other materials, as green vegetables, before they run to seed, soft chalk, tanners' bark, saw-dust, soap-ashes, &c. It is recommended, that instead of being laid in regular layers, they should be mixed as much as possible, in forming the heap. A fermentation is soon excited, and the oftener the heap is turned, so much the more will fermentation be promoted*.

A mode of making compost, was suggested by the late Lord Meadowbank, of which peat is the basis. It was not unusual, in various parts of Scotland, to bed cattle, and even sheep, with peat, for the purpose of increasing the quantity of manure; but Lord Meadowbank was the first individual in this country†, who investigated the properties of that species of manure, and explained them on scientific principles. The result is, that one ton of dung, will ferment three tons of good peat, or moss earth‡. If the moss be of infe-

* Young's Calendar, p. 97. A rich compost may be thus made: mix saw-dust with bullock's blood; add two waggon-loads of this mixture, to three waggon-loads of common mould or earth. This will be quite sufficient for an acre of wheat, applied as a top-dressing.

† Peat-bogs are confined to narrow districts in Italy, and were long considered as useless wastes. But in 1765, Count Fabio Asquini of Fayagna, in the province of Friuli, in the Venetian territories, began to use peat by way of compost.—*Professor Symmonds's Account of the Agriculture of Italy*, Annals of Agriculture, vol. iii. p. 25.

‡ Lord Meadowbank likewise tried the mixture of animal matter, as fish-refuse, whale-blubber, &c. with much success.—It is evident, that peat would be an excellent substance in a compost heap, intended for sandy or

rior quality, it will only ferment two. But if, instead of dung, the refuse of whale blubber be mixed with good peat, a ton will ferment from four to five tons of peat moss. This is a most valuable discovery, and must, if duly attended to, greatly enrich, many hitherto neglected districts. The great advantage of this compost is, that it has nothing but inert vegetable matter to act upon, whereas, when lime is mixed with rich earth, it may have the effect of dissipating the gaseous matters it contains, and of rendering it proportionably less valuable.

2. Composts are peculiarly well calculated for grass-lands. They are likewise of great use to moorish soils, augmenting their staple, and adding to them a number of valuable and enriching substances. In regard to sandy or clayey soils, composts, principally consisting of articles different from their general nature respectively, will improve their texture, and convert them into loams.

3. The effect of composts is highly satisfactory. In regard to grass lands, experience has shown, that they at once improve their quality, and check, for years, the progress of moss, or even unprofitable grasses*. In thin moorish soils, composts properly and repeatedly applied, alter the nature of the soil; it becomes more fertile, retains its moisture longer, and does not suffer by the summer's drought, as would otherwise happen†. The effects of the Meadowbank compost are still more extraordinary: a farmer in Roxburghshire, (Mr. Thomson, of Bewlie), having raised crops of turnips, and of wheat after fallow, on good soils, manured with this compost, as if it had been from dung‡.

It is a circumstance not to be omitted, that lime will operate in compost, upon lands that had been exhausted by the over frequent, or too abundant application of lime or marl, even where it had not succeeded when used by itself. This is a strong recommendation of such mixed manure, as land may thus be cultivated to advantage, that would otherwise remain unproductive.

On the whole, it may be safely asserted, that manure goes much farther in composts than in any other way. It is a safe and effectual mode of applying various substances to the

chalky soils, as it would not only add to them a portion of vegetable matter, but would materially assist in giving them a deeper shade when blended with the soil.—*Remark by Edward Burroughs, Esq.*

* Westmoreland Report, p. 324.

† General Report of Scotland, vol. ii. p. 358.

‡ Ibid. vol. ii. p. 551.

soil. The mass becomes one uniform body, equally nutritious in every part. The gelatinous and mucilaginous substances are dissolved, and intimately mixed with each other, and when applied to the soil, become instantly the food of plants. There is little or no waste from evaporation, but rather a gain of nutriment from the atmosphere; and the quantity may easily be divided and appropriated, according to the size of the field to which it is to be applied, and the quantity which each part may require. It may be mixed with the soil, or applied to the surface;—it may be used at any time of the year, but its effects are more certain, when applied as a top-dressing, either early in autumn, or when vegetation commences in spring;—and it may be prepared at any time, whenever occasion requires its help. If two compost heaps are to be prepared, lime should be the basis of the one, and stable dung of the other, for the sake of comparison*.

From the perusal of this Section, it evidently appears, what endless sources of fertility may be obtained by the active and industrious farmer; and which, aided by judicious rotations of crops, can hardly fail to preserve his fields in a constant state of increasing productiveness. It were to be wished, however, that various doubtful points, regarding the nature and effects of manures, and the most advantageous modes of application, were ascertained by a series of experiments, tried on different soils, in different climates, and under different courses of crops. Agriculture will never reach that perfection and certainty, which it ought to attain, until that measure be accomplished†.

* Remark by the Rev. Robert Hoblyn.

† The late Dr. Fordyce drew up a plan for that purpose, which will be found in the General Report of Scotland, Appendix, vol. ii. p. 124.—It may be proper here to remark, that Mr. Grisenthwaite, an ingenious chymist, of Wells in Norfolk, is employed in discussing the subject of *specific manures*. The theory has taken its rise from the analysis of clover, sainfoin, &c. and the advantage of gypsum to those crops. It is inferred, that by analysis, other specific manures may be applied to other crops. Thus, wheat yields, by analysis, *phosphate of lime*, and a peculiar substance called gluten, of which nitrogen is a constituent. Hence urine, (by folding, for instance), and bone manure, in powder, are indicated for this crop. How much farther the science will advance, is uncertain.

Sect. V.—*On Paring and Burning.*

Paring the surface of the soil, and burning the sods or turf thus obtained, is an operation in husbandry, highly advantageous, when judiciously executed; though, if the subsequent tillage and crops be improper, the soil must necessarily be exhausted, and essentially deteriorated. Hence it need not excite wonder, that the utility of this practice has been much contested. The principles, however, on which this improvement is adopted, are now in a great measure ascertained.

In discussing this subject, it is proposed to consider,—The soils which are calculated for this operation;—The instruments used in paring;—The depth of the turf or sod;—The mode in which the burning should be conducted;—The expence;—The season;—The nature of the ashes, and the substances mixed with them;—Their management;—The crops which should immediately follow;—The rotations to be afterwards adopted;—The advantages of the practice;—Its disadvantages;—and the result of the whole inquiry.

1. *Soils.*—Paring and burning, are, in general, to be recommended, for the improvement of peat-mosses;—of unreclaimed lands, with a sufficient depth of soil;—of chalky downs;—sainfoin layers;—and old rough-swarded pastures. With regard to sandy soils, and also those distinguished for their fertility, the practice ought not to be adopted, unless under very peculiar circumstances.

Fens, and Peat-mosses.—It is scarcely possible to improve fen and peaty soils from a state of nature, to that of profitable cultivation, and in many cases, they cannot afterwards be continued in an arable state, without the assistance of fire*. The spontaneous growth is so worthless, that it must be destroyed; and this is most readily and effectually accomplished by paring and burning, operations to which these soils are peculiarly well calculated. The surface is easily pared;—the soil is more inflammable than any other;—and the turf can be converted into ashes at a moderate expence†.

* Suffolk Report, p. 182.

† Dr. Rennie, who has paid peculiar and successful attention to the subject of peat-mosses, considers those which are highly bituminated and

Unreclaimed Lands.—Where the soil is in a wild uncultivated state, and its vegetative powers in a great measure dormant and inactive, they cannot be called into full action without some stimulus. In that case, the ashes produced by sod-burning, with the acid of lime, are generally necessary, and always effectual*. Indeed where land, covered with thick-tufted coarse grass, is broken up and sown, without having previously undergone this process, the old rubbish carries most of the moisture from the seed, and proves a harbour for grubs, slugs, and other vermin†; whereas when the turf is burnt, these enemies to cultivation are destroyed;—the causes of sterility are removed,—and in its stead, a fertilizing power is created, which, without the aid of this process, could not have been obtained‡.

It is remarked in a work distinguished for its ability, *that the difference between the two methods of breaking up rough ground, (either paring and burning, or ploughing merely), is more than the value of the freehold in favour of the former. The one opens an immediate source of great profit; whereas the other leads to nothing but disappointment and expence*§.

Chalky Downs.—There can be no doubt, that the system of paring and burning, is peculiarly applicable to chalky downs. Mr. Boys of Kent, has given a detailed account of experiments, tried on 267 acres, principally consisting of such downs, and, when the season proved favourable, with uniform success. A single crop thus raised, was often equal to the value of the land in its original state‖. These, and a number of other experiments equally satisfactory, are decisive of the question, that downs and other pastures, ought not to be preserved for the sole purpose of being enabled to fold sheep on the arable land in the neighbourhood, with a view of enriching it; when they can be pared

pyritous, also ferruginous soils, with a yellow or red tinge, as unfit for the operations of paring and burning; but these form merely exceptions to a general rule.

* Middlesex Report, p. 294, note; Derbyshire Report, vol. ii. p. 401, and 403.—In the Appendix will be given a detailed experiment by Mr. Holdich, pointing out the necessity of continuing the paring and burning system, on a fenny soil.

† Middlesex Report, p. 294, note. ‡ Ditto, p. 295, note.

§ Middlesex Report, p. 296. Mr. Simpson's experiments, (North Riding Report, p. 207), are decisive upon this point.

‖ Boys's Treatise on Paring and Burning, annexed to the Kent Report, Second Edition, p. 272.

and burnt, and brought into cultivation with such advantage*.

Sainfoin Layers.—Wherever there are old sainfoin layers, which ought to be broken up, paring and burning are essential for the destruction of the insects, with which such land is usually infested. The utility of this practice has been proved in numerous instances.

Old Pastures.—Many soils formerly cultivated, have been subsequently neglected, till their surface has become mossy, and unproductive, or covered with a luxuriant crop of useless weeds, or coarse herbage. In these cases, paring and burning is the proper system to render such land fit for vegetation. Experiments have been tried of its effects, compared to ploughing merely, and the result has been, that the burnt part, after yielding crops superior to the others in tillage, was free from rushes, and covered with sweet grasses, but that the other part, when laid down in grass, was full of rushes, and coarse herbage†. Indeed, wherever *old swards*, full of matted vegetable fibres, are broken up, they ought always to be treated in that way. But this observation, is not applicable to land that has lain only a few years in grass; or to any land capable of producing good crops of grain, immediately on being ploughed‡.

Sandy Soils.—It can hardly be imagined, that fire would add any thing to the nature of sand, or render it more fertile. In the opinion of an eminent chymist, sandy soils cannot be pared or burnt to advantage§; and as the tendency of its operation on such a soil, would be to lessen, any small small degree of cohesion which it may possess, from whatever cause arising, it must on that account be prejudicial‖.

Fertile Soils.—Where the soil produces sweet herbage, and contains a just mixture of good earth, or where the texture is already sufficiently loose, paring and burning ought not to be practised¶, nor ought turf, *that will readily harrow to pieces*, be subjected to these processes.

The practice, therefore, in Devonshire** and Cornwall, of

* Communication from John Middleton, Esq.

† North Riding Report, p. 228.—See another instance in the Lincoln Report, p. 292.

‡ Northumberland Report, p. 126.

§ Sir Humphry Davy's Lectures, p. 307.

‖ Young's Essay on Manures, p. 131.

¶ Sir Humphry Davy's Lectures, p. 305.—Middlesex Report, p. 299.—See also Kent Report, p. 291.

** In many parts of England, paring and burning is called *Denshiring*, said to be a corruption of *Devonshiring*, in allusion to the early and very general practice of it in that district.

paring and burning *their dry-stapled lands*, as a preparation for wheat, seems to be carried to an extreme, which demands the attention of those who are interested in preserving the permanent fertility, and agricultural resources, of these important districts. The soil there, naturally produces clean, sweet herbage, and never would become so coarse and rough-skinned, as to require that operation. Hence, an intelligent observer, has recommended it to the men of landed property in that county, to guard against the abuse of this practice*. In Ireland also, it appears, that paring and burning the soil, for obtaining potatoe crops, have been carried to a very pernicious excess, and that much injury will be sustained, both by the landlords and by the public, if this practice is not put under some useful restriction†.¶

2. *The Instruments used for Paring.*—The instruments peculiar to this operation are, The fen-plough ;—The breast-plough ;—The cobbing-hoe ;—and, The prong-spade.

The fen-plough has been already briefly described. (Chap. II. Sect. 7). In regard to the breast-plough, or paring shovel, it is calculated to be worked by men. The upper part is made of wood, with a *share* of iron, with which the sod is cut. This instrument is pushed on by means of a hilt at the top; the labour is excessive, but a good hand, will pare about an acre in a week, or rather more, if the work be smooth, and free from impediments‡.—The cobbing-hoe, (*ecobue*), is a French tool, for cutting and raising up pieces of turf, growing on coarse and rough lands, which cannot be pared by the common breast-plough.—The prong-spade, is a tool in the shape of the common spade, but with three or four prongs instead of a plate. It is used for digging the turf on the sides of waste-banks, &c. where the soil is too full of flints or stones, to admit readily the common, or plate-spade. It enters the ground with much less labour than the common spade, and raises the turf equally well§.

The common plough is also frequently made use of, and, in many situations, it is the best instrument for the purpose; particularly when, instead of the usual share, it is equipped

* Marshall's West of England, vol. i. p. 151.—A more enlightened system of husbandry seems now to be gaining ground in these two counties; and the soil is expected to yield its fair produce, without the compulsive sacrifice of its most valuable materials to avarice, or to ignorance.—*Remarks by the Rev. Robert Hoblyn.*

† Remark by Edward Burroughs, Esq.

‡ Young's Calendar, p. 622.

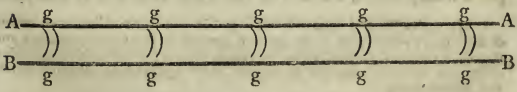
§ Boys's Treatise in the Kent Report, p. 54.

with a paring-spade. By using it, the business proceeds with greater dispatch, and is attended with less expence in the previous cuttings, though by this mode it costs more for burning; but then a greater quantity of the soil is pulverized, and prepared for the ensuing crops, than when the breast-plough is employed *.

Where the plough is used, and the soil is a peat-moss, the horses must often be accommodated with wooden pattens; a particular description of which, with engravings, is given in the Communications to the Board of Agriculture†. In the fen districts, particular attention is paid, to have horses with broad hoofs, that they may be enabled to tread the soft soil with more safety. By their going unshod, this object is obtained.

3. *The Depth.*—The usual depths are, from about one to six inches ‡. In shallow soils the turf cannot be too thin. In Devonshire indeed, they endeavour, by cutting them in small pieces, and driving them about by harrows, to shake out the earth, and to leave nothing but the grasses and their roots to burn. Two inches are generally thought sufficient; but the late Mr. Wilkes of Measham, in Derbyshire, frequently ploughed old, rough pastures, eight or nine inches deep, and burnt the whole furrow; and with the ashes, he not only manured the land pared, but as much more§. This, however, was rather burning the soil, than paring and burning the surface.

4. *Modes of Burning the Sods.*—When the sod or turf is pared by any of these means, it is dried preparatory to burning. This is commonly done by letting the sods lie as the paring implement left them, several days, thus drying their earthy side; then turning the grassy side upwards for two or three days; and if more drying should be necessary, they are placed on their edges, two sods supporting each other a day or two, by which both sides may dry at the same time. The burning process may be facilitated in moist seasons and climates, by the use of portable furnaces, made of old iron hoops of the following figure and dimensions.



* Boys's Treatise in the Kent Report, p. 258.
† Vol. v. p. 5. ‡ Kent Report, p. 243.
§ Leicestershire Report, p. 185.

The two rods, A, and B, lie flat on the ground. The small hoops, *g* and *g*, are rivetted on them. The implement is four feet long, and so light, that a boy can carry it. Turf, after being dried a few hours, may thus be burnt, for if it be laid on the top of the apparatus, with the grass side downwards, the opening left, through which the air passes, necessarily encourages the operation of burning.

In general, however, the sod or turf is burnt, either in small heaps,—in large ones,—or spread on the surface.

It is most convenient for the workmen to collect the sods in small heaps on the field, ten or twelve feet apart, and to fire the heaps by a few red-hot ashes, taken from the heaps that had been previously fired.

Mr. Boys strongly recommends large heaps, each containing twenty cart-loads, as more advantageous than small ones. There would thus be more inside, if properly attended to, converted, by the smothering process, into a carbonaceous substance, by which the ashes acquire more fertilizing properties*.

In one instance, instead of the sward being collected into heaps, it was burnt all over the surface†, in the state in which it was left by the paring spade, and charred, instead of being reduced into ashes. This plan was attended with the best effects; for though the former produce was merely heath and ling, yet it yielded spontaneously, a most luxuriant crop of grass, which continued permanent‡. There is something resulting from heat, applied to the surface of the soil, the advantages of which are not yet sufficiently understood§. It certainly contributes to make the soil more porous, through which both air and moisture more freely penetrate.

5. *The Expence.*—This must depend on various circumstances; as,—1. The nature of the soil on which the opera-

* Boys's Treatise, p. 256. It is on this principle that clay burned in kilns, is considered a superior manure to clay reduced to ashes.

† This is frequently done in the fens, but the ashes are not thought so good, and in fact it can only be done, when the turf is very grassy, and cut thin. It is considered, however, more useful than the condensed mode, in one respect, that it insures the destruction of worms and grubs.

‡ Middlesex Report, p. 370.

§ The effect of heat, in the operation of paring and burning, is remarkable. Wherever burning has been much practised, experience has demonstrated the necessity of removing all the ashes where the fires were made; and though careful farmers remove some of the unburnt earth, still these spots, manifest a deeper green in the crop, than is observable in any other part of the field. The *general* warmth diffused, may probably have a greater effect than is commonly suspected.—*Young's Essay on Manures*, p. 131.

tion is to be performed, and the interruptions and obstacles that may occur*;—2. The price of labour at the time;—3. The instruments that are used;—4. The skill of the labourers employed; and,—5. The state of the weather. But in general it may be remarked, that there is scarcely any process, accompanied with such beneficial effects as that of paring and burning, when properly applied, that can be done at so moderate an expence. In the fens of Cambridgeshire, for instance, the charges of paring and burning, and spreading the ashes afterwards, (when the sod is cut by the plough), costs only at the rate of from 12*s.* to 15*s.* per acre; but the manner of executing the work, by the plough, is there brought to the greatest possible perfection. In other districts, where this operation is less practised, it may be stated at from 20*s.* to 30*s.* per acre. When the breast-plough is used, the amount, which in Kent, was formerly only from 25*s.* to 30*s.*, was raised, in 1803, to 50*s.* per acre†. Even at that sum, or still higher, the expence can be no objection, when it is considered, that on soils suited for the purpose, it is repaid by the first crop;—that this crop furnishes materials that will produce manure for the succeeding crops;—and that land thus brought into cultivation, if cautiously treated, under a proper rotation of alternate green and white crops, and then laid down well manured, and in good order, into grass, will continue productive for a series of years‡.

6. *The Season.*—The *paring*, in favourable seasons, may commence in February; and the sods will thus be ready to receive the beneficial influence of the north-east winds, which are so usual in spring, and which are distinguished by their drying properties. The paring, however, should always be executed in a dry season, to prevent the sods getting into a growing state. The *burning* may begin in March, and be continued till the end of October. What is earliest done, may be planted with potatoes; the next in succession may be sown with turnips; in July with rape; and what is executed later, may be reserved for winter rye, or, on good soils, for wheat. Thus the improvement would

* In some parts of Devonshire, the soil is so tender, that it can be breast-ploughed for 9*s.* per acre, and the burning and spreading the ashes cost only 6*s.* 6*d.* more. *Devon Report*, p. 151.—Such lands ought never to be burnt, except the grass be very old.

† Kent Report, p. 259, 260.

‡ See Dr. Rennie's valuable Section on Paring and Burning, General Report of Scotland, vol. ii. p. 412.

never stop, while the weather permitted the processes to be continued*.

7. *Nature of the Ashes, and the Substances mixed with them.*—It is proved by innumerable trials, that the substances produced by paring and burning, constitute a most powerful manure, and that greater crops may be thus procured, than by any other means. That benefit results from these substances, is put beyond doubt by the circumstance, that if they are removed, the succeeding crop suffers greatly†. The nature of these substances may be thus explained:—1. When the earth has been thoroughly heated by fire, its particles, if separated, lose the quality of coalescing; it freely admits, therefore, the delicate fibrous roots of young plants, and thus promotes their vegetation. 2. Another property which these substances possess, is, the power of imbibing water, and retaining it in the earth, for the purposes of vegetation; and hence their utility, in all those thin and chalky soils, where moisture is desirable‡. 3. Soils susceptible of the greatest improvement from burning, contain a considerable portion of oxide of iron, which the process tends to decompose, and the oxigen thus obtained, may unite with the carbon of the ashes, and produce great fertility. 4. After it cools, the earth probably retains latent heat, which it may communicate to growing plants§.—The carbonaceous matter produced by burning, is, however, the substance of the greatest importance. Though the charcoal of perfect wood, or of pit-coal, has hitherto been found insoluble, that of the smaller sorts of vegetables, readily dissolves in water, and administers food to plants. Great care should therefore be taken, to conduct the process of burning in such a manner, as to preserve this useful article. This may be done effectually, by burning the turf in large heaps, covered with fine mould, so as to keep up a slow smothering fire, and in this way, the whole vegetable matter contained in the turf, may be converted into a carbonaceous substance‖. Burning should never be carried so far, as some writers have recommended. It is sufficient, if the living vegetable principle in the plants, and in their roots, is destroyed, and the texture of the mass, so completely reduced, that it may become a productive soil.

* Young's Calendar, p. 74, 380, and 421.
† Lincoln Report, p. 295. ‡ Kent Report, p. 250.
§ Communication from from John Naismith, Esq.
‖ Kent Report, p. 249.

8. *Mode of Managing the Ashes.*—There are four modes. 1. To spread and plough immediately after they are burnt. This is the common method, and probably the best*, though it is not always practicable. 2. To spread the ashes on the surface, exposed to atmospheric influence, for some months before they are ploughed in. This is done from an idea, (perhaps an erroneous one), that the ashes imbibe some matter from the atmosphere, which adds to their fertilizing qualities†. 3. To leave the ashes in heaps, and to spread them before ploughing, for wheat; a plan not to be approved of, as the alkaline salts will be washed out by the rains; and while the ground on the burnt spot will be saturated, the effete-ashes will be of little or no benefit to the circle around. And, 4. After the land is pared and burnt, to spread lime, at the rate of 150 Winchester bushels per acre, with the ashes upon the surface, any time before the middle of October; the ashes and lime to be immediately ploughed in, by which plan a good crop is insured in the succeeding year‡.

Two rules connected with this branch of the subject, may be mentioned. 1. To sow the seed as soon as possible after the ashes have been spread, and ploughed in; for they operate much more powerfully, when in a caustic state, and the crop will be more abundant; and, 2. To mix lime with the ashes. The two manures seem to assist each other; and indeed, unless there is calcareous matter in the soil, various crops, in particular, barley, pease§, wheat, or clover, cannot be expected to succeed.

9. *Crops.*—It is extremely material, that the first crop to which the ashes are applied, should not be of an exhausting quality‖. Turnips, rape, or tares, are generally recommended¶; or potatoes, when the ashes are got early, and some dung can be applied. In regard to turnips, the ad-

* Where Mr. Ellison, of Sudbrook in Lincolnshire, spread the ashes as burnt, he had a luxuriant crop.—*Lincoln Report*, p. 293.

† Young's Essay on Manures, p. 135.

‡ General Report of Scotland, vol. ii. p. 416.—In North Wales, the ashes of pared sods burnt in June, are frequently left in heaps, without being spread, until seed time, in September or October, when rye is sown.—*Report*, p. 293. See also Derbyshire Report, vol. ii. p. 403.

§ Though the produce of pease may be increased by liming or marling, yet the boiling property is thereby often destroyed.—*Derbyshire Report*, vol. ii. p. 132.

‖ Kent Report, p. 292.

¶ On moist-bottomed lands, rape will often succeed better than turnips; and sheep feed better with rape on such lands.—*Suffolk Report*, p. 185, note. —In Derbyshire they prefer turnips.—*Report*, vol. ii. p. 403.

vantages to be derived from that crop, by means of paring and burning, on land where perhaps they were never seen before, and where they could hardly be otherwise obtained, are inestimable. Each acre, in proportion to the goodness of the crop, will support from five to twelve sheep, during five of the worst winter months; and, besides enriching the soil with their dung and urine, will render the land firm, and consequently an excellent tilth, for a crop of barley or oats, in the ensuing season*. It cannot be too strongly inculcated, that it is by the extirpation of weeds, under the turnip husbandry, that the great advantages to be derived from paring and burning, on chalky soils, can ever produce their most beneficial effects†.

In Scotland, on peaty soils, potatoe-oats are accounted the most profitable first crop, being both early and less liable to lodge, than any other description of oats, and likewise the most valuable variety of that grain; but it is considered a very scourging crop, and, besides the ashes, 150 Winchester bushels of lime must be applied per acre‡.

10. *Rotations of Crops.*—This must depend entirely upon the nature of the soil.

In chalky downs, the following system seems highly advantageous: 1st year, Turnips, or tares, as already mentioned;—2d, Barley or oats. If these crops are sown early, and kept clean from weeds, the result probably will be, a crop equal in value to the fee-simple of the land in its original state;—3d, Clover, trefoil, or rye-grass sown with the preceding crop, to be eaten by sheep§;—4th, Wheat, which will probably be equal in value to *double* the fee-simple of the land, before it was improved by paring and burning;—5th, Tares, or turnips, or both in succession, and fed upon the land, which should be previously manured, in proportion to the two years' straw of the crops it had produced, mixed with any earthy substances that can be obtained. Thus a foundation is laid for a fresh succession of similar crops, while the land, after the original paring and burning, is immediately placed in the highest state of productiveness and improvement‖. Most of the sheep pastures and downs, by this system, may be loaded with the heaviest

* Kent Report, p. 261. † Ditto, p. 293.

‡ General Report of Scotland, vol. ii. p. 413.

§ A second crop of grass will often be necessary, even on such soils, where they are of inferior quality; and in some districts, oats must be sown instead of wheat.

‖ Kent Report, p. 261.

crops of greens, roots, and corn; and these, through the medium of a vastly increased number of inhabitants and domesticated animals, would yield to the public, from 7*l.* to 12*l.* per acre, from lands, which at no time before had produced as many shillings*.

For such soils, however, laying them down with *sainfoin*, as soon as they can be got into good order, is the most eligible plan, as it produces great crops of the best hay, for two years in succession, and for several years after, excellent pasture for sheep.

When oats are taken as a first crop, according to the practice in Scotland, dung can partly be procured, *from the produce of the soil itself*, for raising a crop of either potatoes or turnips, in the succeeding year; but the former is almost always preferred. It is a good rule, that dung should be applied the second year after burning; for half the quantity would do more good at that time, than double the quantity at any time afterwards. After potatoes or turnips, with dung, an abundant crop of grain, and next of grass, may be obtained, and then excellent pasture. The great object is, to lay down the land, as soon as it is practicable, with the grasses best adapted to the soil; and to let it remain in that state, as long as it continues productive. For peat-moss, the soft meadow-grass, *(holcus lanatus)*, with a mixture of rib-grass, is recommended. Marl-grass, with some meadow foxtail, and a small mixture of the pacey rye-grass, will likewise answer well on such soils. Marl-grass, or cow-grass, though resembling red clover in appearance, has quite different effects. It is friendly to all natural grasses growing with it, which clover is not. It is safe for cattle, when cut in a green state for soiling; and not so dangerous to the wind of horses, when made into hay†. For drier soils, the seeds required are, four pounds of red clover, five pounds of white, and one bushel of rye-grass; and if the land be continued in grass for six or seven years, another rotation may then be commenced‡.

A new mode of paring and burning has been tried in Derbyshire; that of paring the stubbles, and burning, in small heaps, the straw, weeds, roots, and part of the soil; the ashes are then spread, mixed with lime; and sometimes, on this preparation, wheat is sown after oats, or stubble

* Communication from John Middleton, Esq.
† Suffolk Report, p 183, note.
‡ Northumberland Report, p. 126.

turnips, followed by oats next spring*. This practice is exhausting, when a crop is immediately taken, but if it were applied to clay soils, *preparatory to a fallow*, it might meliorate their texture, and destroy a number of weeds.

11. *Advantages.*—The benefits resulting from paring and burning, are numerous, and important. 1. By these processes, the various tribes of grubs and insects, which lodge in the surface of the soil, are destroyed†. 2. By the same means, the seeds of many weeds are consumed, by which the crops would otherwise have been injured‡. 3. Not only are the stems and leaves of shrubs, furze, heath, ferns, &c. destroyed, converted into charcoal, and thus prepared for the food of plants, but by extirpating the old sickly roots, room is left for others, younger and more vigorous§. 4. The soil is at once more completely pulverized. 5. The texture of soils, in their natural state, tough, tenacious, and unfit for corn crops, is improved, and prepared for cultivation. 6. By paring and burning, manure is obtained, at a trifling expence, at the commencement of the improvement; it is found on the spot, free from carriage, which in some cases costs more than the manure itself; and a stock of that necessary article is thus provided, which, under judicious management, may serve to keep the land in fertility, until it shall be brought into a regular course of husbandry. These are important advantages, and he must be a bad farmer, who cannot continue, for any length of time, land so enriched, in a high state of productiveness‖. 7. Even the heat communicated to the soil by burning¶, and the mixture of a substance that has passed through fire, is found to be highly advantageous.

12. *Disadvantages.*—Among the objections to this practice it is urged by some, that shallow soils are thus rendered shallower. But others maintain, that the earthy parts of

* Derbyshire Report, vol. ii. p. 406.

† Gloucestershire Report, p. 255.

‡ In new enclosures, where furze and heath abound, paring and burning is absolutely necessary, for these plants cannot be destroyed, even by good husbandry, in any fixed period. On a new enclosure of some land in South Mimms, that had been laid down to grass, after seven years' cultivation, they again appeared in such numbers, that it was necessary to plough the land up again, which would not have been necessary, had the land been pared and burnt.—*Middlesex Report*, p. 300, note.

§ Middlesex Report, p. 247. ‖ Ditto, p. 297.

¶ The Marquis of Tourbilly asserts, that one half of the seed requisite in other soils, will serve on land that has been burnt, and that the crop is uniformly a month earlier than on the adjacent lands: but neither of these advantages has been experienced in this country.

the soil are neither consumed nor diminished by burning*: for though the bulk of the sod or turf be diminished, this arises solely from the burning of the roots and vegetable substances†; and that shallow soils are more improved by the process, than any other; for when thus improved, more of the subsoil can be safely incorporated with them‡. It is likewise said, that as the animal and vegetable matters contained in the turf are destroyed, the ashes cannot possess any properties of a real fertilizing quality: but the crops produced by these ashes, seem to refute that assertion. It is farther contended, that the soil is thus deprived of its natural grasses; but it is also thus deprived of its *natural weeds*, which is a most material object. In regard to grasses, the artificial ones thus raised, afford a much more abundant and valuable article of produce and fodder, than all the natural grasses; which, on lands such as those usually pared and burnt, are generally of the worst sorts.

Some persons have maintained, that it would be a better plan, *to pare only*, and to put the parings in heaps, there to remain till the mass be reduced into mould; when these heaps might be spread on the land from which they came. This, however, is a laborious and expensive process, which it would require a considerable period of time to perfect, and which, after all, would be much less effectual than paring and burning§.

In regard to more general objections;—that it dissipates what ought to be retained;—annihilates oils and mucilage;—calcines salts;—and reduces fertile organic matter, into ashes of very weak efficacy;—it may be answered, that they seem to be either unfounded in fact, or that all these mischiefs are principally to be attributed to the abuse of the system, and are not found to be connected with it, under judicious management‖.

13. *The Result.*—By the process of paring and burning, a stiff, damp, and consequently a cold soil, will be converted into one that is friable, dry, and warm, and much more proper as a bed for vegetation. Though some animal or

* Kirwan on Manures. Trans. of the Irish Academy, vol. v. p. 195.
† Northumberland Report p. 129. ‡ Kent Report, p. 284.
§ Middlesex Report, p. 295.
‖ Young's Calendar, p. 171. An intelligent agriculturist, (the Rev. Robert Hoblyn), maintains, that the burning the roots of vegetables, to *black ashes*, does little mischief; but that the burning the soil to *red ashes*, induces great future sterility. But where the staple is of an adequate depth, a portion of the soil may be advantageously reduced to ashes by the process of burning.

vegetable matter, or manure previously in the soil, may thus be dissipated, yet such temporary disadvantages, are amply compensated, by the destruction of the seeds of weeds, and the roots of coarse shrubs, as well as by the texture of the soil being permanently improved. In regard to soils in which there is an excess of inert vegetable matter, the getting rid of that excess must be beneficial; for the remainder will be rendered fitter for cultivated crops, not only by the addition of calcareous earth, but by the carbonaceous matter remaining in the ashes, which is likely to be more useful, than the coarse vegetable fibre from which it was produced*.

It is evident, that this practice, cannot be either so general, or so successful, in a wet climate, like that of Scotland, as in a country having a less humid atmosphere, and consequently a greater space of time, in which the process can be carried on; but still it is a means of improvement, which is entitled to be thoroughly investigated, wherever the cultivation of the soil is an object of inquiry.

Sect. VI.—*On Summer Fallowing.*

Over the greater part of Europe, it was long considered as an advantageous practice, occasionally to dedicate an entire season, to the cultivation of arable land, without raising from it any crop. The expence of the process, it was supposed, would be amply compensated, by the texture of the soil being ameliorated, by the destruction of weeds and insects, which would thus be effected, and by the increased produce of the succeeding crops. But when the rent of land was increased;—when the expences of cultivation were augmented;—when cleansing crops, as turnips, were introduced;—and when the productions of the soil became more valuable, it was natural for the farmer to consider, whether such great sacrifices were really necessary; and whether fallows might not, in many cases, be diminished, and in others totally given up. On this subject, a controversy has arisen between two sects, the fallowists, and anti-fallowists, which has been conducted with much keenness and energy†.

Of late years, the question at issue, has been much nar-

* Sir Humphry Davy's Lectures, p. 301.

† Mr. Kent, in his Norfolk Report, stated his sentiments in a section, entitled, "Fallowing exploded," which was ably answered by Mr. Brown, in the West Riding Report, under the title of "Fallowing defended."

rowed. It is now, on all sides, admitted, that light soils, (where the culture of turnips is eligible), need not be kept in an unproductive state; and that on strong lands, under a judicious system, summer fallows are not required, more than once in the course of a rotation. The subject under discussion therefore, is reduced to this short question:

Is it for the interest of a farmer, who cultivates cold, strong, clayey, adhesive, and wet-bottomed lands, periodically to fallow them*?

The question shall be considered as applicable to the climate, 1. Of Scotland; 2. Of England; and 3. Of Ireland.

1. *Scotland.*

Wherever the soil is of the nature above described, it is the universal opinion of the most intelligent and experienced farmers in Scotland, that a summer fallow cannot be dispensed with, for the following reasons:

1. Strong clayey soils, if constantly cropped, must often be ploughed and harrowed in a wet state: hence, in a moist climate, they lose their fertility, become hard and stubborn, impervious to the sun and air, as well as to the roots of plants, and require repeated exposure to the atmosphere, before these defects can be corrected. By a complete summer fallow, they are rendered tender and mellow. A tilth is given to them, superior to what can be obtained from a fallow crop, while the soil is rendered so friable, as to resemble that of a garden.

2. The grand object with the skilful agriculturist is, to keep his lands clear of weeds of all sorts; and on strong soils, summer fallow, properly conducted, has ever been found *a sure method* of accomplishing that object. During the short period of dry weather to be found in spring, in such a climate as that of Scotland, the foulness contracted, during the time the land is under crop, cannot always be got the better of, even by a whole summer's labour; any expectations of success, therefore, of cleansing such land, during spring alone, and thereby abolishing summer fallows, cannot be well founded. Nor will hoeing crops answer, for the proper time to clean the land effectually, is in July and August, *and it must be accompanied by deep ploughing*, which can never be performed, if the land be under a crop.

* At what intervals the operation should be repeated, will be explained in the Section "On the Rotation of Crops."

Besides, under no other process, can that noxious weed the thistle, be so effectually extirpated.

3. Fallowing is found to contribute essentially to the destruction of snails, and other vermin in the ground; not only by destroying them, and their eggs, in the course of the operation, but by exposing them to the attacks of rooks and other birds.

4. Its advantages for pulverizing, mellowing, and drying the soil; converting the roots and other remains of vegetables into soluble matter, as food for succeeding crops; for enabling the farmer to remove all obstructions to perfect tillage; and to adjust the surface, so as to promote the discharge of water, and to facilitate future culture, can hardly be questioned.

5. During the fallow process, the land may in every respect be brought into perfect order. All the small drains in the field may be repaired; lime and other manures, may be applied at a proper time, and thoroughly incorporated with the soil. A well-conducted fallow, is more favourable to *the early sowing* of wheat, than a previous crop of beans; indeed on clay soils, in a northern climate, it is impracticable to sow wheat extensively, unless a considerable part of the land has been prepared during the summer months. It is, indeed, almost uniformly observed, that the grain of wheat crops, sown upon regular fallows in September, or early in October, is of the best quality, probably owing to their receiving the greatest heat of the sun, and thereby reaching maturity earlier.

6. But in no other way, than by a summer fallow, can the clay land farmer depend upon a good crop of grasses. Where beans are cultivated, the roots take away that nourishment from the earth, by which the clover root should be fed. The bean also encourages the white snail, a determined enemy to clover. But the year after a fallow, the land rarely fails to produce a crop of clover in great abundance. There is no sacrifice that ought not to be made, to secure a large crop of clover; since, either for soiling, or as hay, it goes much farther in feeding horses or cattle, than any of the green crops that can be raised on a clay soil. Its roots also are so bulky, as to enrich every soil on which it is cultivated.

7. Another advantage of a complete fallow is, that less manure will produce an abundant crop, than when the practice is either neglected, or imperfectly executed. This is an object of much importance, a scarcity of manure, being the

greatest evil, with which the arable farmer has to contend; and this fully compensates for the want of a crop, which is so strongly urged against the fallow system.

8. Exposition to the atmosphere is another advantage. The most stubborn, and unfertile soil, if exposed to atmospheric influence, will be improved in its texture, and rendered much better calculated for the process of vegetation. This is effected, either by the soils acquiring properties from the atmosphere, or by those substances which rendered it barren, being neutralized, destroyed, or washed away. The fact is, that no other means but by a complete summer fallow, can a wet bottomed clay, be discharged sufficiently of the moisture it has imbibed, which having been long locked up in the soil, holds saline and mineral matters in solution. These matters being discharged, the soil readily imbibes fresh water, and gets into a mellow and fertile state.

By these means, the soil becomes more friable, the crops it produces are vigorous, and abundant, and, comparatively speaking, free from weeds.

Some have suggested, that instead of a fallow, the land should be trenched. But even if hands could be procured, heavy clay, the soil which it is alone necessary to fallow, is seldom fit to be dug, as the rain makes it too compact in winter, and in summer, the heat makes it too hard. In Flanders, where so much land is trenched, light soils are preferred for that operation, and it is frequently done by the shovel instead of the spade*.

The expence, and the practicability of substituting a crop in its stead, are next to be considered.

The expence attending this process is considerable. It must vary according to the amount of the rent, and the number of ploughings, harrowings, &c., but the following is considered to be a fair average statement:

	Per Statute Acre.
The six ploughings, harrowings, &c. cost	£3 11 0
Rent for two years, at 2*l.* 7*s.* per acre per ann.	4 14 0
	£8 5 0†

* The expences of trenching, in Flanders, are calculated as follows: 1. Light lands, *eighteen inches deep*, 1*l.* 6*s.* per acre;—2. Strong land, *eighteen inches deep*, 1*l.* 11*s.* 2*d.* per acre;—3. Strong land, *two feet deep*, 2*l.* 5*s.* per acre. In those parts of England where men are to be found accustomed to dig, light land would be trenched at 3*d.* per perch, or 40*s.* per statute acre; and even strong land, at the rate of 4*d.* per perch, or 50*s.* per acre.

† In the Appendix, No. IV. there is a detailed account of the expence of fallowing, on the improved system of the Lothians. In England, the fallow-ploughing is seldom begun, so early as it ought to be, nor is cross-

besides the expence of the crop to be raised, and its share of the manure required for the whole rotation. But the advocates for fallowing, maintain, that these ploughings, and the rent of the land while in fallow, ought not to be charged against the subsequent crop, but to the whole crops in the rotation, as they are all, in a greater or lesser degree, benefited by it.

From the objections urged against a summer fallow, various attempts have been made in Scotland to omit it, but hitherto, unsuccessfully. *Beans* were tried, and they are certainly well calculated for strong soils, being an excellent preparation for wheat. When drilled, they enable the farmer, in some measure to keep his land longer in a clean state, than could be done were that operation to be omitted. Yet their culture cannot prevent fallow from being necessary at certain periods, when the land becomes foul by cropping. *Potatoes*, planted on part of a fallowed field where the soil was favourable, with a greater allowance of manure than the naked fallow, proved so severe a crop, that the part cultivated with potatoes, yielded a less crop of wheat, than the ground that had been fallowed;—the after crops on the fallowed part, were likewise more abundant; and the land much cleaner in the end. *Swedish turnips* were also *sown early*, and taken off the field in September; but the soil was found to be so much exhausted by that root, that the succeeding crop of wheat was less than the usual average.

On this subject, so far as respects Scotland, it may be proper to add, that a great reduction in the frequency of fallows, has already taken place, since the introduction of the turnip husbandry on light land; and though on the clayey adhesive soils above described, they can hardly be ever totally abolished, in that part of the united kingdom, yet there is ground to hope, that, in process of time, circumstances may occur, which may prevent the necessity of recurring to them, even so often as is requisite at present. The climate may improve as cultivation is extended;—by more effectual draining, and the frequent additions of lime and dung, the texture of the strongest soil will be altered, and necessarily become more of a loamy nature;—by repeated cleanings, the quantity of weeds, of all descriptions,

ploughing attended to, without which the process is imperfectly done. The ploughings should also be carried on in the dry seasons, being better calculated for the destruction *of root weeds.*

must be greatly lessened;—instruments also may be invented, which may prove more effectual for cleansing and pulverizing the soil, than those at present in use;—new plants may likewise be discovered, or a more advantageous mode of cultivating old ones may be introduced;—and it is impossible to foresee, what improvements may be effected by draining; in consequence of which, the cultivation of wet and strong soils may be facilitated, and either stock may be fed upon the ground, or its produce may be removed with less injury. But till these alterations take place, the Scottish farmer, will not easily be induced, to relinquish the advantages he derives from a well-executed summer fallow.

2. *England.*

The climate of England, is certainly superior to that of Scotland; yet even in that part of the kingdom, many respectable authorities consider an occasional fallow to be necessary.

Mr. Marshall states, that if land be in a state of foulness with root-weeds, (as half of the old arable lands of the kingdom may be said to be), a year's fallow is *the shortest, the most effectual, and the cheapest* way of cleansing it*. He also accounts it the best preventive of the wire-worm. All animalcula living on herbs, which have not the power of flight, at least in their early states, are best extirpated, by keeping the soil they inhabit, free from every thing herbaceous, especially during the summer months, when they are in a state of activity, and doubtless require daily support. In that case, unabating tillage must prove their destruction†.

In Kent, they have what are called *autumnal fallows*, in which way, the stubbles of fallow crops are prepared for wheat, by several ploughings and harrowings. Barley also is sown late, that it may be thrice ploughed, and operate as a cleansing crop; but after all, the intelligent Reporter of the Husbandry of Kent, (Mr. Boys), states, that there are some untoward soils, which all the art and industry of man, cannot keep clean and in good order, for any considerable length of time, without a fallow; that cold and wet clays, if they were tolerably clear from weeds, are subject, after two or three crops, to run together, to become exceedingly stiff, and to require the intervention of a summer fallow to

* Marshall's Gloucestershire, vol. i. p. 72.
† Marshall's Southern Counties, vol. i. p. 95.

mellow the soil; that a good summer fallow is the best preparation for a crop of clover;—and that the course of, 1. Fallow; 2. Barley; 3. Clover, or beans; and, 4. Wheat, which is the system most practised in the Isle of Thanet, is there considered to be, *the foundation of all good management**. In Essex, fallowing is thought essential, especially for barley. In some parts of the county, half the arable land is under a dead summer fallow; in others, a fourth, a fifth, or a sixth; but the practice is universal, except on dry turnip soils†. Mr. Cheere of Cambridgeshire is convinced, by much experience, that a perfect clean fallow, is indispensable every four, five, or six years. It is necessary, however, that all the requisite ploughings should be given in dry weather.

That celebrated Norfolk farmer, Mr. Overman, gave a strong proof of his concurring in that opinion, for entering upon a farm, where some fields were full of spear-grass, and other weeds, he gave the outgoing tenant 5*l.* 10*s.* per acre, for the privilege of completely fallowing them. He cleaned the ground thoroughly by four ploughings. The soil was sandy, on which a hot July sun, destroyed the root-weeds, without raking or burning‡. Such are the effects of climate.

The Reporter of the Husbandry of Staffordshire, (Mr. William Pitt), explains, in an able manner, the advantages of summer fallows; acknowledging at the same time, that he had once been a sufferer, by too implicit a confidence in the opposite theory. He says, that fallowing for wheat, is practised by the best farmers, on cold, wet, or strong lands; and that he who shall attempt to manage such lands without fallowing, will most probably find his mistake. Fallowing is there necessary, because the roots of perennial grasses, such as couch-grass, &c. cannot otherwise be sufficiently weakened or extirpated; nor can any attempt at extirpation be so successful, by any other means, *as by repeated deep summer-ploughings* §. It appears also, from the Derbyshire Report‖, that whenever the soil is strong, clayey, adhesive, and wet-bottomed, many intelligent farmers in that district, approve of summer fallowing.

There is a most striking coincidence between these, and

* Kent Report, p. 69.

† Young's Essex, vol. i. p. 201, and 205. In Essex they sometimes plough eight times for a fallow.

‡ Young's Norfolk, p. 192. § Staffordshire Report, p. 50.

‖ Derbyshire Report, vol. ii. p. 102.

Mr. Boys's remarks, and the doctrines already detailed on the importance of fallows, from farmers residing in Scotland, though there could not be any previous knowledge, that they followed the same practice, and approved of it on the same grounds.

Mr. Curwen also states, in a recent publication, that the practice of fallowing the more distant parts of his farm, has, with great reluctance, been adopted by him. This practice he considers both requisite and beneficial, in so wet a climate as that of Cumberland, where it is wholly impracticable, in all seasons, to make green crops so free from couch and other weeds, as is necessary for the successful cultivation of the succeeding crops, particularly those of clover*.

But as the system of fallowing, is condemned by authors of great eminence, in reference to southern districts, as either rarely, or not at all admissible, even on strong soils, we shall briefly state their sentiments upon the subject.

Mr. Young only admits a fallow during the first course, advising it to be rejected the second course, and ever afterwards†.

Mr. Marshall is of opinion, that when land is once thoroughly cleansed, it may, by fallow-crops, and due attention, be kept so for a number of years; and more especially, that where the farmers attend so particularly to the seed and vegetating processes, as in the Vale of Gloucester, a whole year's fallow, judiciously made, will be found sufficient to keep land in a state of tilth and cleanness, for ten, fifteen, or perhaps twenty years‡. In another work he maintains, that after an eighteen months' fallow, land may be *so effectually reclaimed*, that it would not require a repetition of the operation of fallowing, *for half a century afterwards*.

But the author who most decidedly disapproves of the summer fallowing system, is Mr. Middleton, the Reporter of Middlesex. Instead of a naked fallow, he recommends a crop of winter tares, which may be obtained in perfection before Midsummer. It is the nature of this crop, he observes, while growing, to render the soil more mellow, than is done by a fallow. It tends to enrich the land, by retaining the air stagnant while the crop is growing; and when the crop has reached maturity, it supports and fattens the

* Curwen's Report, p. 59. † Suffolk Report, p. 51.
‡ Marshall's Gloucestershire, vol. i. p. 75.

farmer's stock. Green tares may be given in racks to cattle and sheep upon the land, if the season permits, or in folds, fixed in convenient parts of the fields. By either of these modes, the soil is abundantly fertilized by their dung and urine. The arguments in favour of a naked fallow, arising from a clay soil, and a moist climate, are thus in a great measure obviated, in districts where winter tares will thrive, and where they run no risk of being destroyed *. As they delight in a moist climate, and, as in England, they come to maturity in June, and require to be taken off the ground during the driest months in the summer, hence the farmer has all the months of July, August, and September, to render his land as clean as a well-conditioned garden, and as fertile as he can desire†.

3. *Ireland.*

In Ireland, the system of fallowing for wheat, is very generally adopted, in most of the corn countries, particularly in strong soils. It is, however, more generally practised by tillage farmers from necessity, than from any real advantage which they derive from it. Among the wealthy and intelligent tenantry, *fallow crops* are usually substituted, except in cases where the land requires draining, or some other operation that could not be performed, if under a crop. Fallowing on strong soils, has yet, however, still many advocates, though all those lands which have been fallowed and cropped alternately, have progressively become less fertile‡; while those on which green crops have been substituted, have not been in the least deteriorated§.

The arguments both for, and against summer fallow, are thus briefly stated, in reference to the circumstances of the three united kingdoms. Difference of climate, may render different systems, in this respect, advisable‖. Nothing,

* Winter tares, unfortunately, are apt to be destroyed by hares and rabbits, being their favourite food; and they run great risks where these vermin abound.

† For a detail of Mr. Middleton's system, and his statements in proof of the superiority which winter tares, and bastard fallows, have over a naked fallow, see the Appendix, No. V.

‡ Nothing else could be expected from so detestable a system, which cannot be too soon exploded.

§ Remarks by Edward Burroughs, Esq. This intelligent agriculturist adds, that he has known instances, in which lands thus exhausted, were in a great measure reclaimed, by growing green crops, and ploughing them in.

‖ Much must certainly depend upon climate. In Jamaica it has been found, that exposing the soil to the heat of the sun, for any length of time,

however, but a personal inspection of the crops grown in Berwickshire and the Lothians, can give an adequate idea, of the perfection to which the fallow system is brought in those districts;—of the immense crops produced after it;—nor of the advantages which are derived from a well-conducted fallow, by the subsequent crops in the rotation. In the culture of wet tenacious clays, therefore, the fallow process has been called, by an eminent farmer, (George Rennie, Esq. of Phantassie), "The main spring of Scottish husbandry;" and it appears from the evidence of an able and intelligent judge in those matters, (J. C. Curwen, Esq. M.P.) who had frequently examined the husbandry of the Lothians, "That clay soils, subject to this process, will produce the greatest crops, and yield the highest rents, of perhaps any in the united kingdom*."

Sect. VII.—*On Weeding Land.*

The subject of weeding, or cleansing land, is of much greater extent and importance than has been commonly imagined. It is not only necessary to clear corn-fields from weeds, but grass lands demand an almost equal attention. Nay, these enemies to useful produce, should be destroyed wherever they are to be met with; for if left unmolested, they will spread their seeds over fields, with a greater rapidity, and to a greater distance, than could well be credited†.

exhausts its fertility, and the practice is disused. Even subjecting lands to the fallow process, for some years, has destroyed their productive powers.

* Mr. Curwen's Report to the Workington Society, an. 1810, p. 88. In his evidence before the Salt Committee, (Report in June, 1818, p. 57), this impartial observer states, "When one looks to the first farming in the kingdom, which I think one may, without injustice to any, attribute to the Lothians, in that system of farming, fallowing is a favourite practice."

† In Japan, the antipathy to weeds has been carried to such a height, that botanists inform us, there is scarcely a single plant that grows naturally in the whole empire; and farmers there, prefer night-soil as a manure, as from using it, they run no risk of propagating weeds. A celebrated naturalist, thus laments the destruction of weeds, and the triumphs of cultivation: "There are beauties in a land yet wild and savage, which disappear at the approach of civilization. In Europe, the soil abounds only in plants, which are of use to man. Domestic vegetables, by the aid and protection of the cultivator, have so trenched upon the domain of the wilderness, that space is scarcely left, for the existence of those, for which man has no call."—*Mirbell's General Views of Vegetable Nature*, inserted in the Quarterly Journal of Science and the Arts, published by the Royal Institution, No. III. p. 41.

From a perusal of the County Reports, it appears, that both in England and Scotland, weeding is too much neglected;—though, in several districts, since the introduction of turnip and other cleansing crops, with row culture, and a more correct mode of fallowing, the ground is kept much cleaner. But still on many farms, weeds continue to occupy a considerable portion of that surface, for which the farmer annually pays rent and taxes; and by their growth, the production of useful articles is considerably lessened.

It is more necessary to attend to this subject, as Nature seems to have made uncommon efforts to preserve these species of plants. Many of them propagate both by their seeds and their roots;—in some cases, the roots are so deep in the ground, that it is hardly possible to get out their lowest joints; while in others, every joint in the root forms a new plant. The extirpation of weeds, under these circumstances, must be attended with difficulty, and it is evident, that where weeds produce seeds apt to fly about, the measures to be adopted ought to be of a general, and not of a partial nature.

In discussing this subject, it is proposed to consider—the various sorts of weeds, the descriptions of lands in which they are respectively found, and how they may be eradicated;—the instruments made use of in weeding;—the expence of the process;—the means of preventing their increase;—the civil or legislative regulations which would contribute to their destruction;—and, the advantages which would ensue, were their extirpation accomplished.

1. *Of Weeds in general.*

Weeds are commonly divided into three classes—*Annuals*, which continue only one year, the plant dying after its seeds are perfected; *Biennials*, which continue two years, and die after maturing their seeds the second year; and *Perennials*, which continue in existence several years. Many of these are propagated both from the root and from the seed.

These different sorts of weeds are found in corn-fields;—in grass-lands;—in hedges;—in waste and uncultivated lands;—and in woods and plantations; and even gardens, notwithstanding the care bestowed on their culture, are not exempted from them.

1. *Corn-Fields.*—In a list given by an intelligent author, of the weeds which infest our corn-fields, no less a number

than *fifty-five* are enumerated*. Fortunately their extirpation can in general be accomplished, by nearly the same processes.

Means of destroying Annual, and Biennial† Weeds.—The most effectual means of ensuring their destruction, on strong land, is by a clean and thorough summer fallow; or by the culture of turnips, potatoes, or tares, in rows, and kept perfectly clean, on light soils; but, for the attainment of that object, it is necessary, 1. To bring the seeds within the limits of vegetation; and, 2. To destroy every weed which vegetates.

1. Seeds of an oily quality, such as those of charlock, (wild mustard), and several other annuals, will remain for a long period of time in the ground, capable of vegetation, when acted upon by moisture and heat. It is absolutely necessary, however, to make them germinate, before their destruction can be effected. This is accomplished, by the operations of ploughing, harrowing, and rolling, by which the ground is pulverized, and a vast number of seeds are brought so near the surface, as to promote their vegetation. In fallowing, those processes should be performed early in the season, when the powers of vegetation are the greatest, and the weeds most likely to come forward.

2. When the first crop of weeds appears above the surface, a second ploughing should be given, by which that crop will instantly be destroyed, and a foundation laid for producing another crop of weeds. Harrowing, and where there are clods, rolling, should also be resorted to, after every ploughing; and in this way, several crops of weeds may be destroyed, in warm and moist seasons, before the succeeding crops are drilled. During the growth of those crops, both the hand, and the horse-hoe should be constantly employed; and the greatest care taken, to prevent all weeds from running to seed.

As the several hoeings given to the cleansing crops, destroy every annual weed as fast as it appears, if the seed furrow, for the crop which succeeds, be not ploughed or scarified deeper than the last furrow given to the cleansing crop, (and a greater depth is then unnecessary), few weeds

* See Mr. William Pitt's Essay on the Extirpation of Weeds, in the Communications to the Board of Agriculture, vol. v. p. 240.—In Marshall's Gloucestershire, 77 are enumerated.

† These are here conjoined with the annual, not having permanent roots, by which new plants are produced after the seed has been perfected.

will appear in the crop of grain which follows; but as the clover stubble, which follows the grain crop, must be ploughed a little deeper than the seed-furrow formerly given, a fresh growth of weeds may then be expected. To get the better of these enemies, some farmers hand-weed these crops, at an expence of from ten to twenty shillings per acre, and have found it much to their advantage; while others have resorted to the drill husbandry, and in that manner have been enabled to destroy them in a satisfactory manner.

By an attention to these measures, the quantity of weeds is regularly diminished; and many farms, which, forty years ago, were a nest of seed-weeds, are now brought into such order, that these injurious plants no longer materially impede the growth of corn*.

Means of destroying Perennial Weeds.—These are by far the most difficult to eradicate, as several of them propagate both by their seeds and their roots. Under this head are comprehended, all the weeds to which the common name of *couch* is given, one of the greatest banes that husbandry has to contend with. Couch is sometimes so interwoven in the soil, when the land has been long in neglected tillage, as to form a perfect matting. Its destruction can only be effected, by an early and complete summer fallow, when, by repeated ploughings, with sufficient harrowings between each ploughing, the roots may be worked out, and brought to the surface. The scarifier or grubber, is also of peculiar service in extracting the couch, after the land has been completely pulverized. Besides collecting the roots by these instruments, it is an excellent practice, to gather them by hand-labour, employing boys and girls to follow the plough, and to pick up every root as fast as it is turned up. When collected, the roots should either be burnt, or deposited in a large heap, and mixed with lime, and thus may become the basis of an excellent compost.

It is proper to observe, that the destruction of root-weeds, as couch, and seedlings, as charlock, must be effected, in arable land, upon different principles; the former, by working them out of the soil in dry weather only; the latter, by pulverizing the soil, so as to induce the seed to germinate after rain, and afterwards ploughing in the young plants.

Among the perennial weeds affecting arable land, thistles,

* See the valuable Section on Weeding, drawn up by George Rennie, Esq. of Phantassie, in the General Report of Scotland, vol. ii. p. 554.

docks, wild oats, and coltsfoot, or tussilago, require particular attention.

The common thistle, (*serratula arvensis*, Linn.), is extremely injurious to all crops. It is for a time repressed, rather than destroyed, by a well-conducted summer fallow; but that is only a local remedy; for its numerous seeds, which are feathered, will often come from a considerable distance, and replenish the field that has been cleared. It is frequently cut close above the ground, by means of a very simple instrument, called a weed-hook; but it is done much more effectually, either by the hand, or by means of a pair of forceps or nippers with two long handles, by which the whole, or part of the roots are pulled up, and the plants either much weakened, or totally destroyed*. In Derbyshire, they make use of a species of tongs, or pincers, *with fluted jaws*, which must be peculiarly effectual†.

The dock, (*rumex acutus et obtusifolius*), is a hardy perennial, very tenacious of growth by its roots, and producing a great increase of seeds. In arable land, the roots should be carefully picked off during the tillage season, otherwise they will produce vigorous luxuriant plants, drawing much moisture and nourishment from the soil, to the injury of the intended crop. Docks ought to be pulled up by hand, after heavy rains, when the soil is soft enough to allow their long tap-roots to be extracted without breaking, and long before the seeds approach towards ripeness, or even before they blossom. If the season be too dry for that operation, they ought at any rate to be cut and carried off.

The wild oat, *(avena fatua)*, is a most troublesome weed to a farmer, and difficult to be eradicated. It formerly abounded so much in some districts, as to constitute one half of the crop. A farmer cleared a field of this weed by a most singular experiment. He dressed and manured it thoroughly, and sowed no crop, trusting to the oats. They grew up most abundantly. He cut them for hay, before

* Derbyshire Report, vol. ii. p. 66. It is said, that the best forceps for that purpose, is the human hand, protected by a suitable glove. Thistles were formerly pulled in Scotland, not because they were weeds, but because they were useful; for owing to the scarcity of grass in summer, they were given to the farmers' horses in the evening. *Aberdeenshire Report*, p. 442.—It is said to be a practice in Germany, after they are collected, to beat them in sacks, till their prickles are destroyed. Horses will then devour them greedily. The roots of couch-grass, after being washed, have likewise been given as food for cattle, in scarce seasons.

† Derbyshire Report, vol. ii. p. 66.

On broad-cast crops of oorn, pincers are the only effectual means of relieving the crop from thistles or docks, should they get but *one* weeding.

the seed was ripe, and the field was never afterwards infested with that weed. Wild oats have likewise been extirpated by irrigation*.

Coltsfoot, *(tussilago ferrara)*, was long accounted almost unconquerable, even by a fallow, the seeds ripening so early in the spring, that they were usually shaken before the ground had got the second furrow. It is now, however, ascertained, that there is little difficulty in subduing this noxious weed. For that purpose, the plants must be destroyed in August, September, or October, after the crops of corn are cut, at which time they are at their full growth, and easily discovered. They ought then to be pulled up, and every stock or root that can be laid hold of, carried off. This should be done most carefully, for about an inch below the surface, the roots have a number of buds about the size of a pea, which, if allowed to remain till next spring, will flower, and shed their seeds in spite of every precaution. This plan should be persevered in for a few years, to give the experiment a fair trial†.

By these means, more especially if accompanied by drilling, cultivated fields may be cleared from the dominion of weeds; and though these several processes are troublesome and expensive, yet they cannot be dispensed with, as they are the only sure methods known of eradicating weeds, for the plan of ploughing them in, (which, at any rate, can only answer in very deep soils), cannot be depended on.

It may not be improper here to notice, the great attention paid by the Flemish farmers to the weeding of their land; and as they know nothing of the drill husbandry in the culture of grain, the whole process is effected by manual labour. In the best cultivated districts, their exertions are incessant; and frequently from 20 to 30 women, may be seen employed in one field, kneeling, for the purpose of greater facility in seeing and extracting the weeds‡. In the Pays de Waes, where the soil is light, the trident, or *fourche a trois dents*, is made use of, after the several crops are harvested, to tear up the root-weeds; and the same

* Dr. Skene Keith's Report of Aberdeenshire.

† The public owes these valuable hints to Mr. Rennie of Phantassie. The process is described at greater length in the General Report of Scotland, vol. ii. p. 554.

It is much the custom with those who fallow land in Ireland, to permit the weeds to shed their seeds, under the idea, that when the land is afterwards ploughed, they will be destroyed. This is one of the reasons, why the lands in that country, under this system, become progressively more foul and more unfertile.—*Remark by Edward Burroughs, Esq.*

‡ This is likewise the case in the Fens of Cambridgeshire.

tool is successfully employed, in breaking the clods in strong land, when they become dry, for enabling the root-weeds to be gathered, and facilitating the pulverization of the soil*.

The clearing of arable lands from weeds, may in general be accomplished by, 1. Complete and well-managed fallows, whenever that operation is required; 2. By taking care that the manure used is free from the seeds of weeds, or any roots that can vegetate; for which purpose, fermenting dunghills is advisable; 3. By a careful choice of clean seed-corn; 4. By short tillages, or not taking too many crops in a rotation; 5. By drilling crops, in soils applicable to that culture; 6. By attentive hand-weeding, and a spirited use of the hoe; 7. By the strictest attention to the choice of seeds, particularly those of grass, that no weeds are intermingled with them; 8. By weeding the land while in grass, so as not to suffer the seeds of any injurious plants to spread themselves; and, 9. Upon breaking up the land, by pursuing such a system of cropping, as will not increase or encourage weeds, and in particular, by adopting rotations in which green crops shall predominate†.

On the subject of weeds in arable land, it is highly material to observe, that their seeds are often mixed with the grain, and when ground with it, render the bread unpalatable and unwholesome. Such weeds are universal enemies, from whose mischievous attacks no individual is exempted, and whose destruction, it is every one's interest, as well as duty, to promote‡.

2. *Grass Lands.*—It is difficult, in some cases, to discriminate, in meadows and pastures, the useful plants, from those that are injurious; but amidst the great variety which nature produces in such lands, there are several, which are not calculated to feed domesticated animals, and ought therefore to be removed, for the introduction of others better adapted for that purpose. No person of common understanding, would ever think of allowing the live stock of his neighbours to feed upon his pastures, as the diminution of food to his own stock, by that circumstance, would be

* Hints on the Agricultural State of the Netherlands, p. 53.

† Pitt's Essay on the Extirpation of Weeds, p. 255.

‡ The white darnel, *(lolium temulentum)*, for instance, if ground into flour with wheat, and the bread eaten hot, will produce deleterious effects on the human body; and if malted with barley, the ale soon occasions drunkenness. *Withering.*—This, however, is a scarce plant with us. The true darnel of agriculture, is the *bromus secalinus* of Botany. It is annual, and grows almost as large and as strong as wheat.

sufficiently obvious. A little consideration, however, may convince every individual, that a multitude of weeds, interspersed among his grasses, produce effects not less mischievous, than those that would ensue from such depredations of live stock. Yet from the Cheshire Report it appears, that in some of the best-conditioned pastures in that county, ragwort, docks, thistles, and knapweed, occupy at least half the land, to the exclusion of an equal number of useful plants*.

Above twenty different kinds of weeds infest grass lands, besides about thirty more, of less importance, whose characters are doubtful, or whose uses are not ascertained. Some of the most worthless, as the rush, *(juncus)*, and the sedge tribe, *(carexes)*, may be got the better of by draining; others, like the mosses, *(musci)*, either by cultivation or manure; but there are a few which require individual attention, before they can be eradicated, in particular the dock, the thistle, and the rag-weed.

The dock has been already mentioned as a weed in arable lands. It is equally injurious to grass, both on account of its seeds and its roots. Its seeds are exceedingly numerous, and heavy, but the stem is flexible, and the recoil from a blast, with a high wind, spreads them to some distance. Docks are found to vegetate equally on turf, and on naked mould. Every bit of root forms a new plant, even after the heart has been consumed by a species of caterpillar. To eradicate this plant in grass lands, the root must be completely taken out by the dock-iron, on, or before the time of flowering, and thoroughly destroyed: this can generally be effected, after much rain. They are refused by cattle; but are eaten by fallow deer, which prevents their flourishing in parks. This plant is best exterminated when the ground is in pasture. It is said, that if it is cut in June, and the operation repeated as soon as the second shoot appears, the root is found to decay, and that it will not germinate a third time†.

Thistles have also been mentioned as infesting arable lands. They are generally weeded out of the corn, but are too frequently left in full possession of the grass-land, by which much damage is incurred; yet these weeds are most successfully eradicated when the land is pastured, as they then stand detached, and can easily be destroyed. The

* Cheshire Report, p. 244. This is also the case in Derbyshire, vol. ii. p. 191.

† North Wales Report, p. 305.

thistle ought to be torn from the main root every year, when the plant is in its greatest vigour; the root itself is thus injured, gradually decays, and the plant is ultimately got rid of. They have been destroyed in a cow-pasture, by mowing the ground for hay three years in succession*, a full proof of the advantages of regularly cutting this plant for a succession of years. They ought to be let alone, till their blossoms begin to appear, for if cut in a young state, fresh shoots are produced from the sides of each plant. When mown in full bloom, the stem is hollow, by which the dew and rain descend into the heart of the plant, and occasion it to rot†; yet as the blossoms in that state, are capable of ripening their seed, the safer way is, for the mowing to take place on the earliest appearance of the blossoms.

The rag-weed, (*senicio jacobæa*), infests some fields more than the thistle, more especially when the soil is sound or dry, for it is seldom to be met with in wet lands. From the number of plants of this species, which are often seen crowding fine pastures, leaving little room for other herbage, it would seem, as if the possessors of the land, held it to be invincible. Sheep are very fond of its young leaves, probably bite off the crown on its first appearance, and thus contribute to banish it from the pastures on which they are fed. But all pastures cannot be occupied by sheep, and neither cows nor horses will touch it. The only effectual mode to destroy rag-weed, is to pull the plant up, just before the flower expands, which is commonly very practicable, as its fibrous roots do not penetrate deep, and are easily taken out, after a plentiful shower‡.

From the large size of the weeds above-mentioned, and the numbers of them which are frequently to be met with in grass land, it is obvious, that great damage is necessarily incurred; much of the herbage becomes inaccessible to pasturing animals; the soil is robbed of vegetable nourishment; and, in some cases, all the country round infested

* Communications to the Board of Agriculture, (by T. A. Knight, Esq.), vol. ii. p. 184. Mowing them twice in the same year, in pastures, would be equally effectual.

† Kent Report, p. 164.

‡ From the Communications of John Naismith, Esq. on Grass Lands. Others recommend cutting the stems before they run to seed, as likely, in process of time, to be effectual.

with flying seeds. The extirpation of weeds, therefore, is not only essential for the interest of the farmer, but a matter of general concern*. On that account, it has been suggested, that every farmer should be obliged, under a statutory penalty, to cut over, in the course of the month of July, all those weeds that are to be found in his grass-lands, in his hedges, or upon the sides of any road that may lead through the farm he occupies. The effects of such a regulation would be highly beneficial†; more especially when there is a malicious encouragement given to thistles or other weeds, as is sometimes the case‡.

3. *Weeds in Hedges.*—Both young and old hedges suffer greatly from the weeds which infest them, and of course their growth is considerably impeded. Indeed young quicks cannot thrive unless they are kept clean. Every weed growing in hedges, is a nuisance, more especially, if it is suffered to ripen its seeds, which are liable to be carried into cultivated land by the wind, or conveyed by water to flooded or irrigated meadows§. There are also some kinds of hedge-weeds, which bear the character of being hurtful to stock. On these accounts, all plants growing in hedges should be extirpated, as useless in themselves, and often injurious to the neighbouring fields, or the domesticated animals which pasture in them.

4. *Weeds in Waste Lands.*—While lands of this description continue uncultivated, it is highly expedient, that, at the joint expence of the parties interested, (if they be held in common), measures should be taken, for destroying weeds, and thus introducing better herbage. Furze and broom might thus be extirpated, and the land sown with hay-seeds in moist weather. Ferns should be mown and carried off in summer, their value, as litter, being well worth the labour. In Norfolk, they are mown by the cottagers, for fuel.

* It is much disputed, whether the butter-flowers, (*ranunculus bulbosus, repens, et acris*), should be considered as a weed or not. Horses are certainly not fond of these plants, but cows will eat the foliage of the *ranunculus repens*, greedily with other herbage.—*Pitt's Essay on the Extirpation of Weeds*, p. 362.

† General Report of Scotland, vol. ii. p. 570.

‡ Derbyshire Report, vol. ii. p. 101, note.—This would be a most beneficial law, and were it extended to Ireland, it would be found doubly necessary. The practice of cutting weeds on the sides of roads, is so very uncommon among the farmers in that country, that the clean and industrious cultivator, has not only to eradicate the weeds natural to his own farm, but also those created through the neglect of his neighbour.—*Remark by Edward Burroughs, Esq.*

§ Ibid. vol. ii. p. 177, 478.

Lands in common, would thus be rendered capable of maintaining a greater number of stock.

As attention has seldom been paid to the draining of such lands, much stagnant water, and several bog weeds, are to be met with. These plants would give way to better herbage, if the bogs were drained, and this ought to be done, by a rate levied upon the inhabitants having right of common, a majority of whom, in value of property, should be authorized by law, to impose it. In this way, the herbage produced would be of a better quality, and the health of the stock pastured upon it, would be better preserved.

5. *Woods and Plantations.*—A great number of plants, that may justly be denominated *weeds,* are to be met with in woods and plantations. As cattle or sheep are not usually admitted into these, until the trees are grown out of their reach, as in groves, it is of less consequence what plants grow upon the surface; but if briars and brambles should appear, they ought to be grubbed up, as making a plantation inaccessible even to its owner; and as ivy is injurious to the growth of timber, by confining and fretting the trees, and depriving them of the nourishment they would otherwise receive, it should be cleared away, before it has too long established itself; otherwise it becomes a kind of garment, the removing of which may chill, and in that way injure the tree.

6. *Gardens.*—A list of twenty-two plants has been given, to the growth of which gardens are liable. Several of them, like the couch, the common thistle, the common nettle, &c. are to be met with in the fields and hedges. Sometimes the seeds are wafted by the wind, and at other times introduced with the manure. Hence the advantage of using fermented dung, by which the vegetative power of seeds is destroyed. From the attention, however, paid to the garden culture, it is seldom that weeds are suffered to grow to any injurious excess.

2. *Instruments made use of in Weeding.*

There are several sorts of instruments used for that purpose, in particular, those for cutting weeds;—for pulling them up;—for digging them out;—also hand-hoes;—horse-hoes;—harrows;—and the scarifier, or grubber.

1. Thistles are sometimes cut by the sickle in corn crops, and by the scythe, or spud, in grass fields; but more gene-

rally by a simple instrument called the weed-hook, when the crops are growing.

2. In several instances, thistles among corn are pulled by the hand. Where this plan is adopted, the hand of the weeder is covered by a strong glove, which enables the person to take fast hold of the weed, and to pull it up.

3. Weeds are frequently rooted out by an instrument called the *docking-iron*. It consists of a forked, or clefted spike of iron, jagged within the cleft, and fixed to the end of a wooden lever; this being forced down by the hand or foot, so as to inclose the root of a dock or large thistle, will easily wrench it up, particularly after rain. In Buckinghamshire, *a small spade*, or *spud*, is made use of for this purpose, with which the best farmers are accustomed, to cut thistles in their pastures, under ground, twice a year*.

4. Hand-hoes are of various sizes, suited to the work intended. In several parts of Essex, wheat is sometimes thrice hand-hoed, and if executed early, especially with a thin crop, it is supposed to be beneficial†. But where so great an expence must be incurred, drilling is to be preferred.

In Gloucestershire, hand-hoeing is still more prevalent. The plants of wheat are set out by the hoe, about six inches from each other, by which the heads are rendered larger and more productive. If any weeds, after all, make their appearance, they are destroyed by hand pulling‡.

In hand-hoeing drilled turnips, the tool is struck downwards, unless when the turnips are to be thinned, or set out, when the operator *shoves and pulls with it*, (as the operation is technically termed), that is, the hoe is alternately pushed across the drill, and drawn back, thus singling out the plants.

5. Horse-hoes are either what are called Dutch-hoes, (provincially *scrapers*), or small ploughs of the ordinary construction. In either case, the hoeing is executed by the aid of one horse; and skilful ploughmen are selected for conducting this branch of rural labour.

* By this means, Mr. Westcar has completely eradicated thistles in his extensive pastures. *Buckinghamshire Report*, 239.—In Thorney Fen, the permanent pastures, have been gradually cleared by the same process.

† Essex Report, vol. i. p. 300.

‡ Gloucestershire Report, p. 116. It is also practised in Worcestershire. *Report*, p. 205.—In 1817, thistles are said to have abounded so much among the barley crops, between Witney and Cheltenham, as frequently to exceed the corn in height.

6. The brake-harrow is a more effectual and expeditious mode of removing root-weeds than ploughing. The teeth should be 15 inches long, not sharp, but set obliquely forward. The land, if perfectly dry, should be rolled and harrowed alternately.

7. But the scarifier or grubber, is perhaps the most effectual implement hitherto invented for the extirpation of root-weeds. (See Chap. II. Sect. 7, No. 1, p. 116), and the knowledge of so useful an instrument cannot be too generally diffused.

3. *The Expence of the Process.*

Considering the important advantages derived from weeding, the expences cannot be accounted great; and they are always amply repaid, if the work be executed with judgment.

The expence of cutting weeds, or pulling them up by the hand, in crops of grain, must vary according to circumstances. Cutting thistles is often done at the rate of from sixpence to one shilling per acre, according to the number of plants with which the land is infested. Effectual hand-weeding will, in general, cost at least 10*s*. per statute acre, but in some cases more. The weeders begin as soon as the annual weeds will bear pulling; they sit, or rather kneel during the operation, as when weeding flax or carrots; and pull every weed that has made its appearance. This expence, however, is amply repaid, by the extra produce of the crop, and by the destruction of such a host of enemies, before they have done any injury to the crop. The expence of *hand-hoeing* crops of grain is very great. When thrice done, it has cost in Essex 31*s*. 6*d*. per acre*.

The expence of weeding turnips by the hand-hoe varies; the first hoeing, being the most troublesome, will cost from 4*s*. to 5*s*. per acre: the second, about half that amount. In some cases, it is necessary to hoe turnips a third time, though the expence is then but trifling, seldom more than 1*s*. per acre; total, about 8*s*. 6*d*. per acre. When beans and potatoes are hand-hoed, the soil not being equally well pulverized, the expence will be at least one-third more than that of turnips, or from 9*s*. to 12*s*. per acre.

The *scraper* will go over an English acre, at the expence of from 1*s*. 8*d*. to 2*s*. When the small plough is used, it

* Essex Report, vol. i. p. 300.

will cost about 3*s*. 6*d*. per acre for turnips, and 4*s*. 6*d*. for beans and potatoes, each time that the land is hoed.

It must not be imagined, however, that the expence thus incurred, can be productive of no other advantage than that of cleansing the ground*. In the month of June, these weeds are in their most succulent state; and if they are collected, and remain for a few hours to wither, cattle that are not pampered, will eat them greedily. Sheep also will eat charlock, and in the fens, if charlock appear among the coleseed, lambs are put in, to eat it off, when in blossom. There is scarcely indeed a hedge-border, or corner of a field, that is not at this season valuable, and whose produce might not be converted into valuable manure; yet in a few weeks, if the transient opportunity be not embraced, it may become a nuisance. The mode of converting weeds into a manure, by mixing them with earth, has been already mentioned (See Sect. 5); but if that be considered a troublesome operation, they may be mixed with quick-lime, or at any rate collected and burnt, when their ashes will be valuable.

4. *Means of Preventing the Increase of Weeds.*

This is a point which requires a number of precautions on the part of the farmer. 1. There is a great risk of carrying a nuisance to his fields, if he use unfermented dung. 2. Great care should be taken, when corn is dressed, that none of the offal, which contains the seeds of weeds, should be thrown upon the dunghill. 3. Seed corn should be thoroughly cleansed from all other substances, before it is deposited in the ground; and, 4. Attentive farmers, will never purchase any seeds, but those of the cleanest and best sorts. Many fields, after being completely fallowed, and sown with grass-seeds with the fallow crop, have been found, when reploughed, to be stored with weeds of various sorts, most probably from some unfortunate mixture in the grass-seeds. The seeds of docks are often sown with clover, and those of other pernicious plants with rye-grass†.

* In Flanders, weeds are collected by hand labour in spring, and are boiled for milch cows, when green food is so difficult to be procured. The farmers thus get their lands weeded by the neighbouring cottagers, *for nothing*, solely for the purpose of procuring these weeds for their cattle, and the farmer is thus gratuitously freed from a great nuisance.

† Pitt's Essay on the Extirpation of Weeds, p. 256. Marshall's Yorkshire, vol. i. p. 368.

The seeds of weeds, are sometimes brought from the uplands in floods, floating on the water, and are left in multitudes by the eddies, along with mud, in particular places*. These ought to be collected and destroyed.

5. *Regulations for the Destruction of Weeds.*

In several countries, the legislature has interposed its authority for the destruction of weeds. By a regulation in France, a farmer may sue his neighbour, who neglects to destroy the thistles upon his land at the proper seasons, or may employ people to do it at the other's expence†. In Denmark, there is a law to oblige the farmers to root up the corn marigold (*chrysanthemum segetum*)‡. But the oldest regulation for that purpose, was probably in Scotland; a statute of Alexander II. about the year 1220, having been directed against that weed, which was considered to be peculiarly pernicious to corn fields§. Under the authority of that law, Sir William Grierson, a Scottish baron, was accustomed to hold *Goul* courts, for the express purpose of fining the farmers in whose growing crops, three heads or upwards of that weed were found‖. Such a plan, if generally adopted, would soon extirpate weeds; and as by a clause introduced into many leases, (and which ought to be universal), the landlord is empowered to cut down these weeds, at the expence of the tenant, if the latter neglect to do it himself; it is much to be regretted, that so useful a regulation should not be generally enforced.

The policy of some legislative provision for this purpose, has been frequently suggested. A clause enforcing the extirpation of weeds, in hedges, along the sides of roads, passed the House of Commons; but was thrown out by the Lords. It is to be hoped, that so useful a measure, even on

* Derbyshire Report, vol. ii. p. 177.

† Maison Rustique, tom. i. p. 640.

‡ See Withering, quoted by Pitt, p. 451. It is stated in the South Wales Report, vol. ii. p. 195, that of all weeds, corn marygolds are the most difficult so extirpate. These weeds, if abundant, are apt to stick together, and to turn into a kind a mucilage, which prevents the crop from drying, and is injurious both to the straw and the corn.

§ See Skene's edit. of Regiam Majestatem; Leges Alex. II. cap. 18. Also Lord Hailes's Annals, Appendix, No. 3. The statute is very short, and ably expressed. It denounces that man to be a *traitor*, "Who poisons the king's lands with weeds, and introduces into them "*A host of enemies.*"—Bondsmen who had this plant in their corn, were fined a sheep for each stalk.

‖ Statist. Account of Scotland, vol. ii. p. 4.

a more extensive scale, will soon be passed into a law. By some it is recommended, that the destruction of weeds on the sides of roads, should be done at the parish expence*; others, by the road-surveyors, and the expence to be stated in their accounts†.

6. *Advantages to be derived from the Destruction of Weeds.*

All plants which grow naturally, among a crop that has been sown, may be regarded as *weeds*, or, in other words, as enemies to the crop that is cultivated. The destruction of such plants, therefore, must be considered as one of the most important branches of the agricultural art; for if that is neglected, or even but slovenly performed, the crops may be reduced to the amount of one-fourth, or one-third of a fair average crop, even upon the very best soils. Besides, it merits consideration, that if weeds are suffered to exist, the full advantages of manuring land, and many other improvements, can only be partially obtained. Nor is this all; the mixture of weeds in the soil, prevents the crop from receiving the beneficial influence of the atmosphere;—sucks up that moisture so essential for the growth of the crop sown‖; —tends more than any other circumstance, to injure the crop when lodged by violent winds or heavy rains;—augments the risks at harvest, (for a crop that is clean, may be ready for the stack-yard in much less time than is required to harvest it, when encumbered with weeds);—and the seeds of these intruders, deteriorate the quality of the grain. Notwithstanding all the injuries thence sustained, how many are there, who hardly ever attempt to remove weeds in an effectual manner§? This negligence is the more to be blamed, because, were farmers at the trouble of collecting all sorts of weeds, before they have formed their seeds, and of mixing them with rich earth, with lime, or fermenting them with dung, they would soon be reduced into a soft pulpy

* Berkshire Report, p. 365. † North Riding Report, p. 240.

‡ This great source of mischief, is not so much thought of as it merits. No plant can thrive without moisture, and hence those weeds, which absorb much moisture, are particularly pernicious.

§ When weeds cannot be extirpated by the horse or hand-hoe, I have always found it necessary, to cut them *twice* when in corn crops—the first about the middle of May, and the second early in July. Some farmers, through economy, (a most mistaken one), cut only once, and this is not performed, till the weeds have grown so rank, that part of the crop is destroyed, and more of it seriously injured. By the *two* weedings, especially on thistles, the crop is kept free of weeds, and the land, of the seed they would consequently produce.—*Remarks by Edward Burroughs, Esq.*

mass, and in this way, a pernicious nuisance might be converted into a valuable manure*.

Various experiments have been tried, to ascertain *the positive advantage* derived from carefully weeding one part of a field, and leaving another part undone; among these, the following, made with peculiar accuracy, may be safely relied on.

1. *Wheat.*—Seven acres of light gravelly land were fallowed, and sown broad-cast; one acre was measured off, and not a weed was pulled out of it; the other six were carefully weeded. The unweeded acre produced 18 bushels; the six weeded acres, 135 bushels, or 22½ per acre, which is 4½ bushels, or ¼ more produce in favour of weeding†.

2. *Barley.*—A six acre field was sown with barley, in fine tilth, and well manured. The weeding, owing to a great abundance of charlock, cost 12*s.* per acre. The produce of an unweeded acre was only 13 bushels; of the weeded, 28. Difference in favour of weeding, 15 bushels per acre, besides the land being so much cleaner for succeeding crops.

3. *Oats.*—Six acres sown with oats; one acre ploughed but once, and unmanured, produced only 17 bushels. Another six acres ploughed three times, manured, *and weeded*, produced 37 bushels. This experiment proves, that oats require good management, and will pay for it as well as other crops‡. Ten bushels of the increased produce may be fairly attributed to the weeding; and the other ten to the manure.

The importance of weeding, both to the individual and to the public, is such, that it ought to be enforced by law. At any rate, a regulation of police, for fining those who harbour weeds, the seeds of which may be blown into their neighbours' ground, can have no injustice in principle. In England, the petty constable might be required, by precept from the high constable, to give in presentments to the

* Forfarshire Report, p. 416. The diminution and deterioration of crops, and in some cases the actual loss, by weeds, is equal to the rent.—*Cornwall Report*, p. 136.

† Mr. Calvert in Nottinghamshire, had a crop of wheat that seemed to be smothered with weeds. He hand-weeded it in April, and the produce was nearly four quarters per acre, weighing 65 pounds per Winchester measure.—*Notts Report*, p. 117.

‡ See an Account of Experiments in Weeding Broad-cast Crops, by Mr. John Wright, of Pickworth, Communications to the Board of Agriculture, vol. vi. p. 387. The weed that grew in the wheat land, is a rampant branching plant, with a blue flower, and is provincially called *Midsummer*, from its growing at that season of the year.

Quarter-Sessions, containing a list of all persons who suffered weeds to run to seed in their hedges or lands, such presentments to be particularly specified to the court. Those referring to the coltsfoot, to be given in at the Lady-day sessions; and those referring to thistles, rag-weed, &c. to be given in at the Midsummer sessions. An order of court might then be made, for the immediate removal of such nuisances, and if not complied with, the offender should be fined a sum not exceeding five pounds, one half to the informer, and the other half to go for the relief of the poor*.

If, in consequence of such a system being enforced, from four to five bushels of wheat;—fifteen bushels of barley;—and ten bushels of oats *additional*, were raised in all the fields in the kingdom, whose crops are injured by weeds, the benefit would be well worth the labour and expence; and the farmers would soon find, that however anxious they may be, to have their lands *tithe-free*, yet to have them *weed-free*, is of still greater importance†.

On the whole, keeping his land in a clean state, ought to be a principal object with every farmer; and if this be not carefully attended to, he may rest assured of paying dearly for his neglect. But the losses which he suffers, do not remedy the injury which the public sustains from his slovenly conduct. The regulations, therefore, which have been suggested, may be considered as both expedient and necessary; for were they adopted, it is evident, that many of the evils alluded to would be removed, and the wealth and agricultural resources of the nation, materially augmented.

Sect. VIII.—*On Irrigation.*

Water is employed in various ways for the improvement of land. 1. By the process of what is strictly called *irrigation*, when water is made to trickle over the surface; 2. By *flooding*, when it covers the soil completely for a period of

* Pitt's Essay on the Extirpation of Weeds, p. 257.

† Cornwall Report, p. 136. Considering the *vivacious* principle with which weeds are endowed, it is not amiss to recollect, that if it were *not so*, there would be little difference between the good husbandman and the sloven. Thus incessant care is excited, and the reward is found, in the esteem that is excited, and in the profit that is produced.

time; and, 3. By *warping*, when the water acts merely as a conductor of the *warp* or mud; by which the improvement is effected. We shall consider these several processes separately, beginning with irrigation.

This subject embraces the following particulars;—The objects to which irrigation is applied;—The methods of conducting the process;—The circumstances necessary to be considered previous to the plan being undertaken;—The waters best calculated for that purpose;—The proper soils and subsoils for irrigated meadows;—The effects of climate on irrigation;—The expence;—The profit;—The grasses best adapted for water-meadows;—The stock fed upon them;—The making and preserving water-meadow hay;—The objections which have been urged against irrigation:—The advantages attending it;—And the improvements of which it is susceptible.

1. *The Objects of Irrigation.*

It is generally supposed, that watering land is only calculated for the purpose of encouraging the production of grass; but irrigation is likewise applicable to the culture of grain, and has even been made use of for promoting the growth of timber.

1. *Grass.*—There are four modes by which water promotes the melioration of grass lands. It preserves a favourable degree of temperature;—improves the crop, by the nourishing substances it conveys;—destroys heaths and other weeds, which delight in a dry soil;—and, as a mere element it is beneficial, more especially in dry seasons*.

Water, as a carrier, likewise conveys other substances to the soil, by which it is enriched. This is, obviously, the case when land is irrigated by muddy waters, which leave behind them rich mould, and other substances. If lime or marl be held in solution, the waters become highly enriching. Other soluble and nutritive substances are also capable of being conveyed by water in the same manner, on passing through fertile tracts.

Meadow plants, cut green, without any external moisture on their stalks or leaves, and afterwards dried, lose by exsiccation, from 66 to 70 parts out of 100. This very large proportion of moisture, (though water is perhaps not the

* See Dr. Singer's Treatise on Irrigation, in the General Report of Scotland, vol. ii. p. 574.—Derbyshire Report, vol. ii. p. 464.

only substance carried off), is a direct proof, that water itself enters largely into the composition of these vegetables. Water is likewise of use, by the more equable diffusion of nutritive matter in the soil, which it necessarily occasions.

The system of watering land, however, can never be carried to perfection, unless when accompanied by *drainage* and *enclosure*. Stagnant water, and impetuous torrents, do essential injury; but if water is entirely under command, so that it may be laid on, or taken off at pleasure, it may become a most useful instrument, in the hands of a skilful husbandman. Drainage is therefore a necessary preparation for irrigation*.

With respect to enclosure, it can be of little real use to water lands, unless they are previously secured, by suitable fences, from poaching and trespass. Indeed these are necessary, not only for the advantage of the grass, but for the safety of the stock, as sheep cannot be suffered to resort to lands flooded in summer, from the risk of rot.

2. *Corn.*—In the East Indies, not only rice, but wheat and barley, are raised by means of irrigation; and it has long been a practice in some parts of Scotland, to enrich the soil for crops of grain, by the same means. Mr. Scrymsoure of Tealing, a gentleman in Forfarshire, followed the practice for nearly fifty years, and with such success, that an enclosure, which had got into an exhausted state, was so enriched by it, that it preserved an uncommon degree of fertility for a succession of crops, (one of them wheat), without fallow, lime, or marl, and with very moderate assistance from dung†. The common method was very different. After watering for one or two seasons, they ploughed for oats, and by taking two or three successive crops, the soil was exhausted, and run out into weeds and poverty‡. Nothing else could be expected from such management. But in other parts of Scotland, irrigation was not only practised with considerable success§, and for crops of grain, but immense quantities of wild oats, formerly prevalent, were completely extirpated, and for the destruction of which no other means were known, previous to the

* In preparing irrigated meadows, covered drains can never be safely resorted to, because the water would almost certainly get down into them, and destroy them; and in most instances, the ridges may be made sufficiently high and steep, to effect a sufficient drainage.—*Derbyshire Report*, vol. ii. p. 465.

† Statistical Account of Scotland, vol. iv. p. 94.

‡ Ibid. vol. xv. p. 82.

§ Ibid. vol. xvi. p. 471.

introduction of fallowing and of green crops*. Water alone, however, without the addition of other substances, will not bring grain to perfection. Hence, though from year to year, it may be applied to meadow and pasture grass with success, yet it cannot be repeated with advantage *to corn*, except at considerable intervals of time, or accompanied with manure†.

The system of irrigating for corn, seems likewise to have succeeded in Somersetshire, where a large tract of country, suffered to remain in pasture for two years, was, during that time, at stated intervals, regularly flooded by a stream descending from the adjacent hills. It was then subjected to the following rotation of crops: 1. Wheat on the ley; 2. Turnips; and, 3. Barley, and artificial grasses. The produce of grain was very considerable, namely, of wheat, from 40 to 50 bushels, and of barley, from 50 to 60 bushels per statute acre‡. In a late publication on the utility of water-meadows, a question therefore is not improperly put, whether, upon particular soils, and under certain circumstances, irrigation might not produce similar effects upon wheat, and several other plants of the field and the garden, as upon herbage? The author adds, no good reason can be assigned, why this valuable improvement should be restricted to the cultivation of grasses§.

3. *Plantations.*—It is recorded in the Statistical Account of Scotland, that irrigation was in one instance used for a very singular purpose. Captain Shand, of Templand, in Aberdeenshire, conducted water through his young plantations, and found, that when done with judgment, it was the cheapest and most effectual mode of encouraging the growth of trees‖. To the alder, the willow, and even the birch and the ash, it may be of use; unless in very dry soils, however, it must be dangerous to forest trees.

But, on the whole, the improvement of grass, seems to be the great object to which the watering of land is applicable.

* Aberdeenshire Report, p. 444.

† Statistical Account of Scotland, vol. xv. p. 88.

‡ Somerset Report, p. 266. This tract is on the demesne of Mr. Luttrel, of Dunster Castle.

§ Observations on the Utility of Water-meadows, by William Smith, Engineer and Mineralogist. Printed an. 1806, p. 39.—Marshall on Landed Property, p. 260, calls it a *probable improvement.*—See also Derbyshire Report, vol. ii. p. 484.—The late Duke of Bedford had it in view, to adopt this plan of temporary irrigation, for arable land. It has been found of great use, at Woburn Abbey, to irrigate strawberries.

‖ Statistical Account of Scotland, vol. xii. p. 286. Parish of Forgue.

2. *The Methods of conducting the Process.*

Water meadows are of two sorts; *flowing*, calculated for a flat country; and *catch-work*, for sloping grounds.

Flowing Meadows.—Where the ground is flat, the soil is formed into *beds*, or broad ridges, like those met with at bleach-fields. They are commonly from 30 to 40 feet wide, and nine or ten poles in length; as, in such situations, the great object is, when once brought on, to be able to carry off the water quickly. Hence it is necessary to throw up the land in high ridges, with drains between them. More of the failures in irrigation arise, from the ridges not being sufficiently high, and the slopes not being sufficiently steep, than from any other cause*.

Catch-work Meadows.—It is difficult to give an intelligible written description of the mode of making these meadows. To be properly understood, the operation must be seen. It may, however, in general be remarked, that the system is calculated for sloping grounds; and that after the water is brought from the original stream, into a new cut, it is stopped at the end, on as high a level as the case admits of, by which the water is made to fill the trench, and run over at the side, and flood the land below it. But as the water would soon cease to run equally, and would wash the land out in gutters, it has been found necessary, to cut small parallel trenches, at the distance of from 20 to 30 feet, to *catch* the water again, (hence the name originated), and the same plan of spreading, or diffusing, is continued, until the water reaches the main drain at the bottom of the meadow†. It is a great advantage attending the catch-work system, that it is not only less expensive, but the same quantity of water will do much more work.

In either of these ways, irrigation promotes the growth of grass. The herbage of dry land is impoverished from the want of water; that of wet land, by its remaining stagnant; but both these evils are remedied by the processes above described.

3. *Circumstances to be considered, previous to the Plan being undertaken.*

The first point to be ascertained is, whether there be a sufficient quantity of water at command. For want of due

* Derbyshire Report, vol. ii. p. 459, and 466.
† Wiltshire Report, p. 119.

attention to this important circumstance, mistakes have sometimes been made, both in England and Scotland, extremely prejudicial to the advancement of irrigation.

The next objects are, the quality of the water, and the nature of the soil, and subsoil, of the land proposed to be irrigated.

It is then proper to consider, *how*, and *where*, the water can be taken out of the stream. This can only be done by a proper level; and the assistance of a professed irrigator will be necessary.

Irrigation being an operation requiring considerable nicety and skill, cannot be advantageously conducted, without attentive hands to form the soil, to lay on and shift the water, and to remove it; also to cut down the produce, and to make it into hay. On all these accounts, a supply of trusty labourers, for carrying on these several processes, must be provided*.

Nor is this all. It is likewise necessary to ascertain, whether there are any obstacles to the proposed improvement, arising from the claims of millers, or canal owners†, (which are often great impediments), the intervention of other property, or from leases granted to the farmers on the estate. The command of capital, adequate to the expence likely to be incurred, is absolutely necessary.

4. *Of the Water calculated for Irrigation.*

Clear spring-water, in the state in which it issues from the hills, (more especially where the strata are calcareous), is certainly of a fertilizing quality. It is charged with a considerable quantity of vital air; near the source also, it is usually warmer than other waters, and thence it answers better for irrigation, more especially during severe weather in winter. From these properties, there is always produced, abundance of early succulent grass, for several yards where the water first runs over the land near the spring. Clear spring-water, may also be used longer than the foul or muddy, being less apt to render the grass gritty, and unwholesome; hence some give a decided preference to clean-watered crops‡.

* Communications by Mr. Boulton, a flooder, or floater, from Gloucestershire. General Report of Scotland, vol. ii. p. 596.

† The owners of canals, ought to be the greatest promoters of irrigation. The waste water of the canals in England, might irrigate many thousand acres.

‡ Smith's Observations, p. 68 and 74.

Mountain streamlets, fed principally by springs, are more at command than rivers, and more convenient to be directed over slopes, and are also better calculated for improving grass.

Where river-water is accessible, it is commonly loaded with many enriching substances from the country, and the towns and villages through which it passes; and is thus productive, not only of temporary, but of permanent improvement.

Sea-water also, where it can be employed for that purpose in moderate quantities, or made use of within embanked marshes, is applicable to the purposes of irrigation. It contains, more especially near the land, not only animal and vegetable substances, but also saline mixtures in solution. The utility of salt marshes to diseased horses, and their acting as a restorative to sheep in danger of, or infected by, that fatal malady, the rot, in well known. Those ideas are corroborated by an observation, that the meadows near the mouth of the Severn, *where salt water is spread over the lands by the tide*, are grazed, instead of being mown, and are accounted the best possible pasture for horses and cattle that require rest, and spring physic*.

In regard to waters much impregnated with iron, they were formerly supposed totally unfit for the purposes of irrigation; but it is now fully proved, by the accurate experiments of an able chymist, and by the extraordinary growth of grasses in Prisley meadow, in Bedfordshire, that ferruginous waters are friendly to vegetation, when properly applied†. Chalybeate springs, however, or water impregnated with other mineral substances, as lead or copper, never does good; and it is well known, that waters of that description, after they have been brought into fields, by levels cut at a considerable expence, have again been diverted, and suffered to flow in their original channels‡.

Waters that are impregnated with the juices that flow from peat-mosses, are considered by many, not worth applying to the soil§. It is objected to them, that they are soon frozen;—that they convey no material nutriment;—and that they are commonly loaded with such antiseptic

* Gloucestershire Report, p. 165.

† Smith's Observations on Irrigation, p. 28.

‡ Remark by the Rev. Robert Hoblyn.

§ These waters generally hold in solution, a portion of oxide of iron, commonly called "*green vitriol*," supposed to be a preventive of the rot, as sheep in the Cambridgeshire fens, where that substance abounds, never take that disease.

substances, as will retard, instead of promoting vegetation*. It is urged on the other hand, that a want of sufficient slope in the meadow, or of proper management in regard to the water, may have occasioned the disappointments experienced in some cases, when bog-waters have been applied†.

5. *Of the Soil and Subsoil.*

Irrigation is not restricted to any particular description of soil. Land naturally wet, may be greatly improved by it, when accompanied by drainage; and it is equally beneficial to that which is dry‡.

Rich loams produce the largest crops, even though the waters be not of the first quality. Peat-bogs, when properly drained, will likewise yield good crops§. Irrigating adhesive clays is expensive, and the beneficial effects from it do not soon appear; but it is evident, from a meadow near Longleat, that even this sort of land may, by good management, be thus rendered more fertile; and it is well known, that some of the best meadows in Gloucestershire, and at Woburn, are upon a clayey substratum‖.

Barren slopes may be advantageously improved under the catch-work system; and in this way, much land, at present covered with heath, furze, or broom, may be rendered productive of hay, or valuable grasses. The most suitable soils, however, are those of a sandy or gravelly nature; more especially when they can be irrigated by muddy streams, the sediment of which corrects their excessive openness. Indeed, by means of the warm and rich waters, of a low, fertile, and populous district, impregnated with mud, and containing animal and vegetable manures, almost any soil may be converted into a rich meadow.

The bottom or subsoil of a water-meadow, is of more consequence than even the quality or depth of the soil. A loose gravel, or bed of broken flint, with little or no intermixture of earth, where that can be obtained, is the most

* Dr. Stringer's Treatise, p. 579. † Derbyshire Report, vol. ii. p. 463.

‡ Smith's Observations, p. 26.

§ Water is of great benefit to peat-bogs, or mossy grounds, by washing away improper ingredients, as the sulphate of alum, by which that description of soil is rendered unfertile. In this way peat-bogs may be enabled to produce succulent and nutritive grasses, and to rival the best natural meadows.

‖ Smith's Observations on Irrigation, p. 44; Derbyshire Report, vol. ii. p. 462.

desirable subsoil. With such a bottom, in seasons when water is abundant, a soil, not six inches in depth, is quite sufficient to produce large crops.

Effect of Climate.—The process of irrigation, seems to be attended with much more beneficial effects, in warm, than in cold climates. The difference of the seasons between Gloucestershire, in England, and Aberdeenshire, in Scotland, produces very important consequences. The latter is usually about five weeks more backward than the former: hence, it is hardly possible, to get such early crops of spring grass, in the districts of Scotland, as are easily to be obtained in England; and thus one of the principal objects of irrigation, (feeding ewes and lambs in spring), is thought to be unattainable. Nor will the application of water produce two, and sometimes even three crops of hay in Scotland, as it does in North America. The advantages of water-meadows, however, are important, independent of spring feed; more especially when the catch-work system can be adopted, as the expence of that process is inconsiderable.

6. *The Expence.*

This varies according to the nature of the work. Where the catch-work system is practicable, in favourable situations, the forming may be done as low as 10*s.* per acre. This fact is, in many cases, decisively in favour of this natural and simple mode, which requires also much less water, and often answers fully as well as flat flooding*.

The expence of *bed-work*, as it is called, is, however, considerable. If the ground to be flooded, be smooth on its surface, or in regular ridges, and if the water can easily be brought to the meadow, with a temporary weir, supposing the extent to be almost 20 acres, it may be done at from 5*l.* to 10*l.* per acre; but if the land be of large extent, with an irregular surface; if a large conductor, and a proper weir shall be required, with hatches both in it, and also in the feeders; and if the aid of a professional person, to lay out and oversee the work, be necessary, (which is generally the case), the expence will vary from 10*l.* to 20*l.* per acre†. Nay, in Wiltshire, where they are anxious to have their meadows formed in the most perfect manner, with that re-

* Observations by Mr. Boulton, the Gloucestershire flooder.—General Report, vol. ii. p. 599.

† Observations by Mr. Boulton.—General Report, vol. ii. p. 598.

gularity which the nice adjustment of water demands, the expence per acre, has amounted to forty pounds*.

7. *The Profit.*

The profit resulting from this operation, when properly conducted, is always considerable. Mr. Wilkinson proves, by authentic documents, that all the outgoings, both capital and interest, were refunded within two years, besides a very considerable permanent increase in the value of the land†. Mr. Eyres derived great advantage from his meadow, even the first season, by pasturing on it sheep, cattle, and even cart-horses‡. Mr. Clough found that land, which, before irrigation was applied, was not worth more than six shillings per acre, was thereby increased in value to 2*l.* 15*s.* per acre, even to a farmer; and if let to the inhabitants of a market-town in the neighbourhood, would fetch 3*l.* 10*s.* if not more§.

The following is the statement given, of profit from the formation of an irrigated meadow, on the estate of the late Mr. Ferguson of Pitfour, in Scotland; who carried on that species of improvement with much energy and success.

	£	s.	d.
1. Interest, at 7½ per cent. on the original expence of making, 10*l.* on an average per Scotch acre, ...	0	15	0
2. The old rent of the land, ...	0	10	0
3. The annual expence, ...	0	8	0
	£1	13	0

The annual value being raised to 4*l.* per acre, hence, it is calculated that there is a clear profit of 2*l.* 7*s.* per acre, per annum‖.

* Smith's Observations on Irrigation, p. 56.—Various accounts were transmitted to the Board of Agriculture, of the expence of making water-meadows in different districts. The Rev. Mr. Clough, near Denbigh, in North Wales, expended 868*l.* in forming about 30 acres into a water-meadow, which is nearly at the rate of 30*l.* per acre. *Comm.* vol. i. p. 263.—Mr. Eyres, of Lynford Hall, in Norfolk, improved in the same manner, 23 acres, at the expence of about sixteen guineas per acre, besides some extra charges. *Ditto*, vol. vi. p. 329.—Mr. Wilkinson, of Potterton Lodge, near Wetherby, in Yorkshire, converted thirteen acres into water-meadow for about 12*l.* 12*s.* per acre. *Ditto*, vol. vi. p. 43.—And two spirited farmers of Norfolk, (Mr. Beck of West Lexham, and Mr. Purdy of Castle-Acre), have tried irrigation with great success, at an expence of 30*l.* per acre.—*Ditto*, vol, vii. p. 108 and 112.

† Communications to the Board of Agriculture, vol. vi. p. 45.

‡ Ditto, vol. vi. p. 329. § Ditto, p. 269.

‖ General Report of Scotland, vol. ii. p. 601.

A very distinct account is given, of the expence and profit of a water-meadow, in the Hampshire Report. The produce is stated at 9*l.* 3*s.* 4*d.* per annum, without including the advantage of folding the sheep from the meadow, on tillage or other uplands, which is estimated to be worth 16*s.* 8*d.* more, or, in all, 10*l.* The expences, including the interest of the money expended in forming the meadow, amount to 5*l.* 18*s.* 6*d.*; leaving a balance of 4*l.* 1*s.* 6*d.* in favour of the meadow.

It is, however, contended, that neither the grass, nor the hay, produced by irrigation, contains those feeding or fattening qualities which are found in upland herbage. The stock will "hold their own," or keep to the state they were in, when put to such food; they will increase in size, but not in condition. Others will not admit to its full extent, the truth of that doctrine; and besides maintain, that the benefits resulting from irrigation, are sufficiently ample, to support the practice, even though its produce may not possess a feeding or grazing quality*. Nor is the pecuniary profit arising from irrigation, so material, as those indirect, or secondary advantages resulting from the system, which shall afterwards be detailed.

8. *The Grasses best adapted for Water-Meadows.*

Where the catch-work system is adopted, the surface of the meadow is rarely much broken; the natural grasses in the ground are trusted to, and it is seldom necessary to procure any seeds, except for bare or vacant spots. When ridges, however, are formed by the spade or the plough, they are generally destitute of grass when first laid down. It is necessary, therefore, to sow the seeds of such plants as are best calculated to produce valuable and abundant crops. The most usual are, 1. *Perennial red clover*, cow, or marl grass; *(trifolium medium)*; 2. The rough-stalked meadow-grass, *(poa trivialis)*; and, 3. The crested dog's-tail, *(cynosurus crystatus)*. Timothy, *(phleum pratense)*, is greatly preferred for water-meadows in America; and, in boggy lands, fiorin, *(agrostis stolonifera)*, is found peculiarly productive in that species of soil. Where the object is pasture, rather than hay, white clover, rye-grass, and the meadow fox-tail ought not to be omitted. The soil of itself, when watered, will produce grasses, the most congenial to the state of the land, and the degree of moisture applied to

* Hampshire Report, p. 277.

it; but a little manure, at the commencement of irrigation by beds, (unless the turf has been pared, and preserved to be put upon the surface), is thought by some advisable. In short, the superior grasses in general, will thrive under irrigation.

9. *The Stock to be Fed on Water-Meadows.*

The advantage which a sheep farmer derives, when the climate will admit of it, by feeding his ewes and lambs *in spring**, on a watered meadow, can hardly be sufficiently estimated†. At that pinching period of the year, food is always scarce,—and lambs, once checked in their growth, cannot afterwards be fattened. There is an interregnum, (if the expression may be used), between the vegetation of one year, and that of another, which is best supplied by an early crop of grass. Where this expedient is not resorted to, or where Swedish turnips, cole, or savoys, (kail), are not extensively cultivated, the farmer may have no succulent food to give his flocks, and he will of course suffer severely. During spring, Bakewell recommends, that no heavier stock than sheep, or calves, should be admitted on the meadow. Much, however, depends, upon the quality of the soil and subsoil, for where either consists of gravel, a farmer can feed his milch-cows during the spring, and after making a considerable quantity of cheese, may obtain three tons of hay per acre‡. In Wiltshire, after a crop of hay is taken, it is not usual to attempt a second, unless hay is very scarce; for the grass being of a soft nature, it takes so much time to dry, that it can seldom be well made into hay: and it is of much greater value when fed with dairy cows, which may remain on the meadows, till the flooder begins to prepare for the winter watering§. In autumn, fatting beasts, and even cart-horses, have been put on a water-meadow‖.

* It is generally supposed, that sheep would be *rotted*, by pasturing on watered-meadows at any time, except *in the spring;* but in Derbyshire, there are several well authenticated instances to the contrary. *Report*, vol. ii. p. 472 and 475.—Much probably depends upon the slope, but more on the soil or water being calcareous. It is said that in Ireland, sheep and lambs are rotted on water-meadows *even in spring*, but that is not the case in England.

† Half an acre of water-meadow will support 1000 sheep per day, in spring.—*Smith's Observations*, p. 111.—*Wiltshire Report*, p. 127.

‡ Smith's Observations, p. 111.

§ Wiltshire Report, p. 128.

‖ Communications to the Board of Agriculture, vol. vi. p. 47.

10. *On Water-Meadow Hay.*

The grass of water-meadows, being frequently large, and coarse in its nature, makes it advisable to cut it young; and then, if it be well made, the hay is of a nourishing and milky quality, either for ewes or dairy cows. It has likewise been given to horses, and when properly made, they thrive upon it*.

It is proper, however, to observe, that from the great succulence of the herbage, the making of water-meadow hay, requires a very considerable degree of attention†; and that when the grass from which it is made, has been overwatered, or rendered impure by scum or mud; or when the hay has been ill made in the fields, or injured in the stacks, it will be hurtful to any stock to which it is given: but that altogether originates from mismanagement; and it has been found by experience, that cows, if they do not fatten so well, yet give much more milk from hay produced by irrigation, when cut early, and thence having much softness and succulency, than from any hay produced from grass-lands, that had not been irrigated‡.

11. *Objections urged against Irrigation.*

Some have asserted, that water-meadows render a country unhealthy, by making the water stagnant; but no opinion can be more erroneous. In fact, where meadows are irrigated, the water must constantly be passing over the surface, with a brisk current, and always kept in motion, to be of any service. Many of the best meadows also, in their original state, were unwholesome morasses, the draining of which, has essentially contributed to the salubrity of the air§.

Others think, that though the produce may be increased, it becomes in a few years of so coarse a nature, mixed with rushes, and water plants, that cattle frequently refuse to eat it, and when they do, their appearance proclaims that it is far from being of a nutritious quality‖. But this objection is never applicable to meadows skilfully made, and

* Buckinghamshire Report, p. 283; Transactions of the Highland Society, vol. iii. p. 201, and 283.

† Dr. Singer has given some very judicious directions for that purpose.—*General Report of Scotland*, vol. ii. p. 610, &c.

‡ Berkshire Report, p. 370, note.

§ Wiltshire Report, p. 122.

‖ Rutland Report, p. 114.

properly managed; and whenever the grasses are coarse, they should be cut earlier, if intended for hay. Rushes and water plants are proofs, that the meadow lies too flat, and is ill managed.

12. *Advantages of Irrigation.*

Where the situation is favourable, the following benefits result from the practice of irrigation. 1. With the exception of *warping*, it is by far the easiest, cheapest, and most certain mode of improving poor land, in particular if it is of a dry and gravelly nature. 2. Land, when once improved by irrigation, is put in a state of *perpetual fertility*, without any occasion for manure, or trouble of weeding*, or any other material expence. 3. It becomes so productive, as to yield the largest bulk of hay, besides abundance of the very best support for ewes and lambs, in the spring, and for cows and other cattle in the autumn of every year. 4. In favourable situations, it produces very early grass in the spring, when it is doubly valuable; and, 5. Not only is the land thus rendered fertile, without having any occasion for manure, but it produces food for animals, which is converted into manure, to be used *on other lands*, thus augmenting, in a compound proportion, that great source of fertility†.

Were these advantages more generally known, or more fully appreciated, a large proportion of the kingdom might become like South Cerney, in Gloucestershire, where every spring, or rivulet, however insignificant, is made subservient to the purpose of irrigation, fertilizing, in proportion to its size, either a small quantity, or a large tract of land‡.

13. *Improvements suggested in the Practice of Irrigation.*

In some recent publications on the subject of irrigation, hints are suggested, for the farther extension and improvement of that operation.

* The large water-dock is the weed that principally infests water-meadows. It ought to be carefully eradicated.—*Smith's Observations*, p. 40.

† In Davis's Wiltshire, it is calculated, that 2000 acres of water-meadows will, on a moderate estimate, produce in four or five years, 10,000 tons of manure, and will keep in permanent fertility 400 acres per annum of arable land.

‡ Gloucestershire Report, p. 280.—Watering of land, is also of use, by destroying vermin in the soil. Bakewell practised this with success in lands under tillage. Red worms were thus destroyed; and snails, and grey slugs, though they in general like moisture, and injure crops most in damp weather, yet do not agree with wetness.

The first is, that of watering land by machinery. If the land be put in a proper form for irrigation, and supplied with a good stream, at proper seasons, there can be no difference, from the method of getting it on the surface; and if all other circumstances are equally favourable, the same fertility may be expected, from water thrown up by a drain mill, as that which runs from a brook*. A cheap and effectual power, for raising water in sufficient quantities, to flow about ten acres at a time, would be an invaluable acquisition; for a productive water-meadow, is probably the true mark of perfection, in the management of a farm†.

The other suggestion is, that of employing machinery, to raise not only fresh, but even sea-water, for irrigation‡. It is well known, how much all kinds of stock are improved by salt marshes, and how beneficial to them, is a moderate quantity of saline matter. There are many parts of the kingdom, where, by the aid of machinery, these advantages might be obtained at a moderate expence§.

Sect. IX.—*On Flooding Land.*

The mode of improvement by "*Flooding*," is, when the land is overflowed, or *drowned* by a quantity of water, from a stream or lake; by means of which, (if it takes place in a favourable season), the future production of crops, both of grass and of grain, is promoted. It differs completely from irrigation, in which the water ought constantly to be in a *flowing state*, whereas in the process of artificial flooding, it is wholly or nearly stagnant. The great object of the process is, 1. To admit the water, without any injury to the surface of the soil from the force of the stream that is admitted; and, 2. To withdraw it in such a soft and regular

* Smith's Observations on Water-Meadows, &c. p. 93.
The celebrated wheel invented by Mickle, and employed for raising water to float off the moss, at Blair-Drummond, in Stirlingshire, might supply the water. Mr. Boys mentions a wind pump near Deal, that costs only thirty guineas, and would raise 1600 butts in twenty-four hours.

† Middlesex Report, p. 322. ‡ Smith's Observations, p. 87.

§ Several works are published, which give practical directions, for the formation and management of water-meadows: as those of Wright, and Boswell;—Smith's Treatise, above quoted,—and Mr. Young's Calendar. In the Appendix to the General Report of Scotland, vol. ii. p. 130, there are a number of useful plans and suggestions, by Mr. John Boulton, a native of Gloucestershire, who had been for seven years an irrigator there, and has since practised for above 12 years in Aberdeenshire.

manner, that none of the mud, deposited on the surface, shall be taken away.

Along the margins of many of the rivers in England and Scotland, the meadows are thus improved—When the floods take place in winter, or spring, they produce the most fertilizing effects; but these flat grounds, being rarely protected by embankments, they often suffer severely from overflowings in summer and autumn. The management of these meadows, on improved principles, shall be discussed in a subsequent Section. (Chap. IV. Sect. 3.)

The most striking instance known in Great Britain, of advantage being derived from the inundations of a lake, is, that of *Loch Ken*, in the Stewartry of Kirkcudbright. At the head of that beautiful piece of water, there is a flat of about 240 statute acres, which is rendered, by flooding, one of the richest spots in Scotland. Many acres in it, produce at the rate of three tons of hay each, and some parts of it, have been cropped with grain, for 25 years in succession, without any manure, except what it receives from the inundations it experiences. These, however, leave behind them, a variety of enriching substances*.

The advantages of *flooding*, in favourable circumstances, cannot therefore be too highly appreciated; and it evidently appears that water, in a *stagnant state*, may produce the most beneficial effects, more especially where the surface is incumbent upon an open subsoil or bottom.

From the advantageous consequences of flooding, when done by nature, there is reason to imagine, that the same benefit would result from it, when artificially executed; and this was formerly attempted in various parts of the kingdom. Hence the obsolete practice of *floating upwards*, as it was termed. For that purpose, the water was penned, in times of floods, by means of a dam or flood-gate across the bottom of the meadow, or flat to be watered. The waters were not suffered to remain long upon the land, but were let off, as soon as it was judged that they had dropped their sediment†. The benefit arising from this method of using flood waters, it is said, was considerable; but when the improved mode of irrigation, by floating ridges, was introduced, and found more advantageous, the other was discontinued‡.

* Statistical Account of Scotland, vol. iv. p. 260.

† The plan resembled in principle the modern system of warping.

‡ Marshall's Midland Counties, Minute 27.—The system of *floating upwards*, ought, however, not to be given up, as it may answer in many cases, where irrigation cannot be practised, but at an enormous expence.

Besides these meadows, mill-ponds thus fertilized, were rendered dry, and cropped with oats; artificial pieces o. water, were likewise filled up, and became productive; and by means of sluices, and other contrivances, low grounds and bogs were laid under water during the winter months, and greatly enriched, with productive vegetable earth, from the surface of the higher parts. The waters were let off in spring, and the ground was then ploughed and sown*. But in consequence of the great humidity of the soil, the crops were very late, and in a wet summer, they were lodged and spoiled. In dry seasons, however, and where proper attention was paid to the draining and ridging of the soil, the returns were considerable, and the land was enabled, without manure, to raise good crops of grain†.

In discussing this mode of reclaiming waste land, it is proposed to consider the following particulars:—The manner in which the plan ought to be carried into effect;—The mode in which the flooding operates;—The kinds of water either proper or improper for the purpose;—The seasons fittest for the operation;—and, The advantages and disadvantages attending it‡.

1. *Manner of carrying the Plan into Effect.*—This plan of improvement, is only calculated for tracts, where there is a command of water, and an opportunity of stemming it up, so as to overflow the whole surface. In many places, there are such situations, in particular all land-locked peat-mosses, that lie on a level lower than the adjacent springs or rivers. In some districts, 200, 300, and even 400 acres of mossy land, may be laid under water, by a single bank at the outlet, which may be effected at a trifling expence. Merely by shutting up such openings, and stemming the streams that flow through them, this species of improvement can be *artificially* accomplished.

2. *Mode in which the Flooding operates.*—Some ingenious reasons have been assigned, for the advantages resulting from this process; as,—that it promotes the fermentation of any vegetable matter with which it comes in contact;—and that the mechanical weight of a body of stagnant water, must tend to consolidate, and to improve

* After fens are flooded by the breaking of banks, the water generally lies on the ground during a whole year: much mischief is done, but the land produces afterwards great and clean crops.

† Colonel Fullarton's Report of Ayrshire, p. 48; and General Report of Scotland, vol. ii. p. 361. The crops should be sown on lazy-beds.

‡ The observations on the flooding waste lands, are principally taken from Dr. Rennie's Treatise upon that subject, printed in the General Report of Scotland.—Appendix, vol. ii. p. 17.

the texture of a soft soil:—But the salutary effects of flooding, may principally be ascribed to the advantages of moisture, so essential for vegetation; and to the particles of sand, clay, earth, calcareous matter, and other adventitious substances, with which the waters are impregnated. In peat-bogs also, flooding has a powerful effect, in decomposing the antiseptic quality of the tan, or colouring matter contained in the bog, and carrying it off.

9. *The Waters calculated for Flooding.*—All sorts of water, are not equally adapted for the beneficial practice of flooding. Pure spring water, especially such as issues from calcareous strata, answers the purpose well: and if it can be used in sufficient quantities, will convert heath, and coarse herbage, into sweet pasture grasses. Soft, and also muddy waters, may be employed with advantage. River water is often impregnated with a number of useful ingredients; and the quality of water may sometimes be artificially improved, by a mixture of calcareous and other substances. But waters that issue from peat-mosses, or soils impregnated with pyrites, or bituminous oil, are said to be injurious,

4. *The Seasons fittest for the Operation.*—The object of watering meadows, is essentially different from that of improving waste lands by means of flooding. In the former case, water is frequently made use of, to nourish the grasses already produced by the soil. In the latter, the purpose is, to destroy the indigenous plants, as they are generally useless. Hence, though covering the soil with water *in winter*, is of use, yet the greatest improvement must be effected by *summer flooding*. *The heat of the sun*, combined with water, produces a putrid fermentation of the vegetable matter on the surface of the land; after which, when the land is left dry, the coarse and useless herbage disappears, a rapid growth of succulent grasses rises in its place: this is the case on even steril mosses.

5. *Advantages and Disadvantages of the Process.*—The great advantage of *flooding* is, the cheapness of the process, and the facility with which it is executed. On the other hand, it is only in very flat countries that it can be used to any extent; and if it be carried on upon a great scale, covering great tracts of country with water, in cold, and still more in the warm seasons of the year, it must render the climate moist and unwholesome*. At the same time,

* In the end of summer, and beginning of autumn, if there is *a severe frost* for a few hours, its effects are peculiarly destructive near flooded lands.

where the situation is favourable, it can hardly fail to be attended with benefit, in a pecuniary point of view.

Sect. X.—*On Warping Land.*

There is no circumstance, which proves more clearly, the advantages to be derived from minute and extensive inquiries, adopting for their basis, the political divisions of the country*, than the discovery of the process called *warping land.* This most valuable species of improvement, applicable wherever tides in their course keep alluvial matters in a state of suspension, was confined to a small district on the banks of the Humber; and though it had existed there for about 50 years, yet not a syllable concerning it, had ever found its way into a page of printed husbandry, and it might have remained unknown for many years longer, had not the Board of Agriculture undertaken the survey of the kingdom, in the course of which it was brought to light†.

In discussing this subject, it is proper to consider,—The origin of the practice;—The nature of the improvement;—The means of effecting it;—The season most suitable for the purpose;—The expence and profit;—The mode of cultivation and produce;—The situations where it may be attempted;—and, The improvements and the extent of which it is susceptible; together with some account of a species of river warping in Italy.

1. *Origin of the Practice.*—It is said, that the person who made the first experiment of warping, was Mr. Richard Jennings of Armin, near Howden, in Yorkshire, who tried it about the year 1743‡. But it was about the year 1753,

* When the political divisions of a country are made the basis of inquiry, no part of it is overlooked or neglected;—and if there is reason to expect, that every local useful practice may be brought to light; and ample information obtained, regarding the real state of a country, and the means of its improvement.

† Lincolnshire Report, p. 326.

‡ Mr. Day of Doncaster, (West Riding Report, p. 171), states, that warping was first tried "about 50 years ago," and his information was given anno 1793. Mr. Marshall was informed at Booth Ferry, near Armin, that one Barker, a small farmer at Rawcliff, was the first warper of land; and that Jennings of Armin, was a steward or professional person, *who extended the practice.* Tradition says, that Barker, like other men of aspiring genius, hurt himself at the outset, (as is too often the case), by the prosecution of his scheme, which he was, in consequence, on the point of giving up; but laying his case before a friend, he advanced him fifty pounds, which enabled him to complete his grand design, by which he afterwards

before it was attempted by any other person; and it remained in obscurity, till the beginning of November 1793, when it was made public by three eminent farmers, who had been appointed by the Board of Agriculture, to draw up a report of the husbandry of the West Riding of Yorkshire*. As the Board had only met for the first time, on the 4th day of September preceding, the discovery of warping, in less than two months, is a striking proof, of the zeal and activity of those, appointed to carry on its inquiries.

2. *The Nature of the Improvement.*—The water of the tides that come up the Trent, the Ouze, the Dun, and other rivers which empty themseves into the great estuary of the Humber, is muddy to an excess; insomuch, that in summer, if a cylindrical glass, from twelve to fifteen inches long, be filled with that water when the tide is high, it will presently deposit an inch, and sometimes more, of what is called *warp*, or a species of mud of great fertility. This substance probably originates from a variety of earthy particles, washed down by the rivers to their mouths, where they are mixed with saline and other matters, with which the sea abounds, and by agitation are rendered so fine, as to be suspended, when the water is agitated by the tide. Some of it was analysed by an eminent chymist, whose report was, that it contained mucilage, and a very minute portion of saline matter; a considerable quantity of calcareous and most probably aluminous earths; the residue mica and sand; the latter in by far the larger quantity, and both in very fine particles†.

3. *Mode of carrying the Plan into Effect.*—The plan of securing by embankments, rich alluvial soil, has been practised for ages; but it was reserved for modern times, to conduct mud-laden waters, *artificially*, from the estuary or river in which they flowed, for the purpose of furnishing

made a little money, so as to be able to forward his children's progress in life. One of his sons is now settled in business at Hull. Mr. Marshall very properly adds, that those who have made, or are making fortunes by this discovery, ought to ascertain who made it, and should lose no time, in raising a monument to his memory. *Eastern Department*, p. 107, note.—Mr. Wells, of Booth Ferry, near Howden, mentions it as a tradition, that the utility of this process was *an accidental discovery*. A stubble field was inundated with water from the river, and covered with mud. The benefit which the field derived from the enriching substances thus brought to it, was the cause of Mr. Barker's proceeding.

* Mr. George Rennie of Phantassie, Mr. Robert Brown of Markle, and Mr. John Shirreff, then farmer at Captainhead in East-Lothian.

† Lincolnshire Report, p. 316.

low and barren ground with a sufficient depth of fertile soil*. The mode of executing the plan is extremely simple. When the improvement is determined on, the ground must first be surrounded with banks, from three to four, six, or seven feet high, according to circumstances, that the water may be of a proper depth on the land to be warped, and to prevent the contiguous lands, whether cultivated or not, from being overflowed. The tide is then admitted, and detained, until the sediment in the water is deposited, upon the surface of the land. To render the plan efficacious, there must be a complete power over the water, either to keep it out, or to let it in, according to circumstances; and to accomplish these objects, there must be, not only a cut or canal made to join the river, but a sluice, (provincially *clough*), to open or shut, as required. The effect is very different from that of irrigation, for it is not the water that produces the effect, but the warp or mud; and the great object is, not to manure, *but to create a soil* of the richest quality, and that at a moderate expence†.

4. *The Season for Warping.*—June, July, and August, are undoubtedly the best months for warping, on account of their being in general the driest seasons of the year. Land, however, may be warped in any season, provided the weather be dry, and the fresh water in the river very low. When the season is wet, and the river full of fresh water, this operation cannot be advantageously executed. The fresh water, in this case, stems the tide, and occasions a degree of stagnation, favourable to the repose of the prepared matter, and consequently it is not half so muddy, nor capable of depositing the same quantity of sediment, as when the tide flows in more freely, and stirs up the mud. Warping, in spring, is attended with no peculiar advantage, more than in summer, as there can be no crop the first year. The sediment must lie to soak and dry, before the ground can be cultivated‡.

5. *The Expence and Profit.*—It is impossible to calculate the expence, without ascertaining the situation of the lands proposed to be warped; the sum it will require to embank the lands, to build the *cloughs* or sluices,—to cut the drains, &c.; and the quantity of land, the same drains and cloughs will be sufficient to warp; for the greater the

* Marshall's Eastern Department, p. 103.
† West Riding Report, p. 164.—Lincolnshire Report, p. 315.
‡ Ditto, p. 170.—Marshall's Eastern Department, p. 105.

quantity, the less will be the expence per acre. There are *great quantities* of land, however, which might be warped, for so small a sum, as from 3*l.* to 4*l.* per acre; an expence trifling, when compared to the profit that is derived from the operation. Mr. Webster, at Bankside, in Yorkshire, purchased a farm of 212 acres, which he warped. The price was 11*l.* per acre, and the expence of warping about 12*l.* more, or 23*l.* in all. It was immediately rendered by warping worth 70*l.*, and in some parts, even 100*l.* per acre, at which price warped land frequently sells: but even at 70*l.* the profit is immense. Mr. Webster warped some moor-land, worth only 1*s.* 6*d.* per acre, (for such land there is in that neighbourhood), and could immediately let it for 5*l.* per acre.

6. *The Mode of Cultivation and Produce.*—The best mode of cultivating new warped land, is to sow it with clover, and to let it lay under that crop for two years, in order that it may be brought into a state fit for corn.—It does not answer to sow land, immediately after it is warped, with wheat, even though fallowed; but after white, or red clover, for two years, a good crop of wheat may be relied on, unless injured by the slug, which sometimes makes its appearance*.

Nor is it proper, when land is warped, to plant it with potatoes, or to sow it with flax, being at first of too cold a nature; though these crops may answer, if the land be not too strong for potatoes, after it has been for two or three years in cultivation. In the quality of warped land, there are most essential differences; some will be very strong, and in the same field some will be very friable. The land nearest the drain is in general the lightest, owing to the quantity of sand that is deposited as soon as the water enters the field: the land farthest from the drain, is, in general, the best. The produce of warped land varies much; but in general, it may be stated, of wheat, at from 20 to 40 bushels; of beans from 35 to 50, and in some rate instances 90 bushels; and of oats from five to eight quarters per acre. Warped lands require manure, and will not carry many crops without its aid, even where the situation is dry, and the soil fertile†.

* Their depredations might be prevented, by salt strewed on the surface after the crop was sown.

† It is not improbable, that the practice of warping, may be greatly extended. Perhaps warp might be raised by machinery from the bottom of the estuary, to be brought up by the tide; and if the water impregnated with

7. *Can the Process be extended?*—Some doubts are entertained, whether this great repository of highly prepared matter in the Humber, may not be exhausted*. But there seems no just ground for such apprehension, when the great extent of the estuary in which it is found, is considered, or the vast tract of country, which, for ages, has been pouring down these valuable substances into its bosom. At the same time, it would be desirable to remove every doubt of that sort, by as accurate examinations of the banks or the bed of the river and shoals in it, as is practicable in such cases. If upon inquiry it should be ascertained, that the quantity of warp is as immense, as there is reason to expect, it is to be hoped, that such a treasure, surpassing perhaps, any other that the country is possessed of, will not be neglected. We have the means in our power, of converting land worth only a few pence, to yield a rent of 5*l.* per acre per annum; or in other words, of transmuting *copper into gold.* The efforts made in Egypt, to obtain, and to secure the fertility of its soil, in circumstances not very dissimilar, are well known; and shall nothing be done by the British Government, to promote an imitation of the husbandry of the Nile, on the banks of the Humber, and of other rivers where it may be found practicable? Why not give some species of public encouragement to so great a national object†? more especially as the valuable substance in question, (silt or warp), is not confined to the Humber, but is to be met with in many of our other rivers and arms of the sea, in great perfection and abundance.

8. *Of River Warping in Italy.*—From some late accounts which have been published, of the agriculture and statistics of Italy, it appears, that a species of warping has been long known in Tuscany. It is there called *colmata.* The rivers

it, were raised to a higher level, it might be conveyed to a greater distance, and the sediment kept in a flowing state, would not be deposited, till it was suffered to rest. It might be worth while to convey the warp itself, when deposited, to a certain distance, on iron railways, or canals, which are so easily made in a flat country; and which was actually done by the Duke of Bridgewater, to a considerable extent, on his celebrated canal. It is an excellent dressing for garden-ground, and is said to be an antidote to the rust or mildew.—*Dumfries-shire Report*, Appendix, 531.

* Marshall's Eastern Department, p. 115.

† In Chapter V. the means of promoting such undertakings, by public encouragement, shall be explained. It is a most unfortunate circumstance, that there should be such a prejudice against the granting of public encouragement to promote agricultural improvements. Were such improvements properly attended to by the Government of the country, no individual in it need to remain unemployed.

in that country, carry down with them vast quantities of mud and sand, by which their discharge into the sea is impeded, and great marshes are formed, not only at the mouths of these rivers, but in their courses, when they are passing from one level to another. Torricelli, it is said, was the first who taught his countrymen to enclose the marsh with a dyke or embankment;—to admit, into this enclosure, the water of the rivers;—to force this water, by means of sluices, to remain stagnant as in a lake, so as to deposit its mud;—and by the sediment so produced, to raise the level of the bottom. At one time, three or four inches of earth has been often deposited;—the operation has been several times repeated in the course of a year;—and the level so much raised, that the ground is no longer liable to be overflowed by the river. The soil thus acquired, is of the highest fertility; and an instance is mentioned, of a piece of ground thus treated, which had yielded 25 measures of wheat from one*. Necessity was the parent of this operation in Italy; whereas, on the banks of the Humber, it seems to have originated from accident, and has been carried on, by a zeal for improvement, and the prospect of gain.

Sect. XI.—*On Embankments.*

The nature and advantages of embanking are two-fold; 1. To protect land, already under profitable production, from the encroachment of the sea, of fresh-water lakes, or of rivers, which often inundate the low grounds in their neighbourhood; and, 2. To reclaim from the sea, or large rivers, land overflowed by them, and to render it useful territory.

1. *Protecting Lands from Inundations.*

This is a subject of considerable extent and importance. In many districts, the sea makes perpetual inroads on the

* Edinburgh Review, for March 1817, p. 44, 45. Torricelli, the celebrated inventor of the barometer, was born anno 1608, and died anno 1647. There is a good account of this Italian process, in the travels of W. A. Cadell, Esq. in the years 1817, &c. See also the Scottish Farmer's Magazine, published in May, 1820, p. 160. It appears, that by the process *Colmata*, the ground is rendered unproductive for seven or eight years; but by the English system of *warping*, it will produce clover immediately after the process is completed.

land; in others, lakes, during the rainy seasons of the year, or after the melting of snow, spread their waters over the adjacent flat land; while, above all, there is scarcely a river in the country, that does not, every season, commit devastations along its banks, either rendering large tracts unproductive, or destroying and sweeping away the harvests.

1. *Protection against the Sea.*—Where the coast is defended by bulwarks, consisting of loose, soft, and penetrable materials, they are often broken down by the sea, more especially in high tides. The extent of land on the coast, is thus proportionably diminished, and considerable injury sustained. Bulwarks for preventing such encroachments, are, in most cases, both difficult, and expensive in the execution, and often precarious in point of permanency. The power of water, when impelled by strong wind, is not easily resisted; and when the sea is to be contended with, the barriers erected against it, ought to be constructed with peculiar care, as many circumstances may occur, to obstruct their execution, and to overturn them when supposed to be completely finished*.

To prevent this mischief, artificial barriers of stone, or of wood and stone, should be erected, to stop the progress of encroachment; but sometimes, banks of shingles, and even of sand, found on the spot, have answered, by an attentive imitation of nature, in the formation of shoals, and ridges of the beach†. Where the object is, to protect such low parts of the coast, as are subjected to inundation by the flowing of high tides, a regular bank should be formed, the breadth, height, and strength of which, should be made, in proportion to the depth and weight of water it may have to resist. As a farther security, piles should be driven into the shore, in front of the bank, to break the force of the waves. By this expedient, the walls receive no farther injury, as the space between the piles, and the bank, is, in this manner, rendered tolerably smooth, however tempestuous the waves may be without‡.

* Johnstone's Chapter on Embankments, in the General Report of Scotland, vol. ii. p. 615.

† Mr. Smith, the mineral surveyor, has effected this on the coast of Suffolk, with much ability. Mr. Maddocks's great embankment on the coast of Wales, seems to be of the same description.—*Communications to the Board of Agriculture*, vol. vi. p. 150.

‡ Beatson's Essay on Embankments; Communications to the Board of Agriculture, vol. ii. p. 244.

2. *Protection against Lakes.*—In general, lakes are subject to temporary and extraordinary swells, occasioned by violent winds, great falls of rain, or by the melting of snow; consequently, they often spread beyond their usual limits, overflowing and injuring the neighbouring land. The effects are so injurious, as to make it an object of importance, to prevent or lessen them, by enlarging, and where the level will admit it, deepening and widening the outlet, that the water may at all times have a more free and easy discharge. In some cases, the lake has been surrounded by an embankment, extending not only along the sides of the lake, but of the streams that flow from it, and that by which it is discharged, as far as the level requires; nay, it must sometimes be carried to the higher ground on both sides, to prevent the flood from having any access to the flat land exposed to be overflowed. This, however, is a very operose and expensive undertaking, and can only be effected, where a drain from the embanked ground, will fall into a river below the lake; otherwise the embanked ground would be filled with water.

3. *Protection against Rivers.*—There are two modes by which this can be effected: 1. Deepening the channel; and, 2. Raising embankments to protect the flat ground in their neighbourhood.

1. Where the course of a river is in a straight line, or nearly so, it hardly ever makes any encroachment on its banks, unless perhaps in very large rivers, when they rise above their usual level, either by an increase in their own waters, or their flow being in some degree interrupted by the tides. Hence, whenever a river is narrow in its channel, and winds considerably, any mischief it commonly occasions, may be prevented, by deepening and straightening the course of the stream. In one instance, where this improvement has been effected, it has produced the following important advantages. The waters, which in their crooked course, were formerly almost stagnated, now run at the ordinary rate of the declivity given them. They never overflow their banks. Cattle can now pasture upon those grounds in which they would formerly have been swamped. The surface of the water being now, in general four, and sometimes six feet, below that of the adjacent fields, this cut serves as a general drain to the whole valley; so that three hundred acres of meadow, may be converted into arable land; sixty acres of moss, may be improved into

meadow; and five hundred acres of arable land, are rendered of double their former value*.

2. The protection of banks against a river, to prevent its overflowing, and inundating large tracts of country, if judiciously executed, is the simplest and easiest of all sorts of embankments. Few rivers of common size, rise more, even in the greatest floods, than five or six feet above their customary level, unless they meet with some considerable interruption or confinement in their course, which probably can, with little difficulty, be removed. In some cases, this may even preclude the necessity of embanking, but where that is necessary, the embankments on the two sides, ought to be placed at a sufficient distance from each other, so as to contain with ease between them, the largest contents of the river, in the greatest floods. The distance and height necessary to be attended to, in forming the banks, may easily be ascertained, by measuring a section of the river, when at its highest, or when the flood-mark is visible.

When a sufficient distance is allowed between the embankments, their perpendicular height need not exceed four or six feet, but their slope should be considerable. If irremoveable obstacles are in the way, which cause the river to rise higher, the banks must be made either more distant, or higher in proportion.

The materials for making these banks should be taken, as much as possible, from the sides of the river, which will have the double effect, of widening the river, and forming the embankment; and there should be a trench on the inside, (from which materials may also be taken), with some sluices to discharge any water from the land side. It is proper to add, that sluices ought likewise to be made, for admitting the water from the river, the advantages of which, for fertilizing meadows, at certain seasons of the year, cannot be doubted†.

When the facility, and the trifling expence at which this improvement can be effected, are considered, it is matter of surprize, that extensive tracts of the richest meadows, should be allowed to remain in a state liable to be overflowed by every flood. When these floods take place during the winter, or early in spring, the water deposits a fructifying

* Statistical Account of Scotland, vol. xviii. p. 220—Stirlingshire Report, p. 280.

† In the Gloucestershire Report, p. 264, there is an account of a valuable embankment and drainage, by which 1300 acres of land are improved, where the surface of the river is above that of the adjoining meadows.

slime, which promotes vegetation, and is friendly to the growth of the best kinds of natural grasses. But the floods often come, when they are least of all desired, when the grass is far advanced, when the hay into which it is converted, is ready to be carried to the stack*, or when the crops of grain are ready to be harvested. A crop may thus be destroyed, the value of which would have erected an embankment, that, with moderate repairs, might have preserved it in perpetuity†.

One great cause that prevents the improvement of such meadows, is, that, in England, many of them, after the hay has been cut, are in a state of commonage, the remains of feudal barbarity. In such cases, the most spirited and well-informed cultivator, is checked in his exertions to ameliorate that property, in which others are thus interested, if they will not contribute to the expence. *A general law* for promoting the improvement of meadows thus circumstanced, would be of essential benefit to extensive and valuable tracts, and add considerably to the produce and opulence of the country.

In Scotland, the strict fetters of entailed estates, are a great obstruction to such improvements, which a general law, with proper regulations, might in a great measure obviate.

2. *Reclaiming Land from the Sea, or at the Entrance of large Rivers.*

The embanking of land that has been, perhaps for ages, overflowed by the sea, by large lakes, or rapid rivers, is one of the greatest and boldest enterprises attempted by man; and the success with which it is generally attended, is an ample proof, of what human industry is capable of effecting, when its powers are called into action, and when self-protection and interest are the objects in view. The works of this sort executed in Holland, would have been deemed incredible, had they not been accomplished in our own immediate neighbourhood; nor are there wanting examples of such embankments in our own country, which do credit to the skill and enterprising spirit of those by whom they were undertaken.

* Berkshire Report, p. 236.

† This actually happened at Wester Fintray, in Aberdeenshire, where several hundred quarters of corn were carried off, by a sudden flood, in 1768. The farm has since been embanked.

The first object to be considered, before attempting to reclaim land, which, at low water, is left uncovered by the sea, is, whether or not the soil to be gained, is of a nature capable of cultivation, and fit for the other purposes of agriculture; for in many cases, what is exposed at low water, and might easily be embanked in, is an accumulation, to a great depth, of barren sand or gravel, unfit for any useful purpose*.

On many parts of the coast, however, the sea, at low water, recedes so far, as to leave dry, large portions of surface, in the bays and creeks of the shore, where the soil is of a rich and fertile kind, being rather a deposition of fine earth washed down from the land, than of barren gravel or pebbles thrown up by the sea. Land of that description, will, in general, amply repay the expence of the embankment; the amount of which must depend upon the depth of the water, the force of the tide, and the prevalence of winds in that quarter.

At the entrance of large rivers, whose estuaries are wide, and in which the tide ebbs and flows, immense tracts are frequently left bare at low water, where much fertile land may be acquired. Embankments, in such cases, have strong claims to the consideration of those active and public-spirited individuals, whose estates are contiguous, and by whom the work may be executed at their joint expence.

The plans for carrying on such undertakings, do not belong to this work†. But from the preceding observations, it is sufficiently obvious, that embanking is one method of improving, or acquiring land, well entitled to general attention, and in many cases, to public encouragement.

Concluding Observations to Chapter III.

Whoever has fully considered the various particulars above detailed, must be astonished at the perfection, to which these branches of the art of agriculture, have been already brought, in our time, and in this country. These have been much promoted by the establishment of a Public Institution,

* Johnstone's Chapter on Embankments, General Report of Scotland, vol. ii. p. 626.

† The plans of executing Embankments, are fully explained in Beatson's Essay on that subject, Communications to the Board of Agriculture, vol. ii. p. 231; and in Johnstone's Chapter on Embankments, in the General Report of Scotland, vol. ii. p. 615.

whose object was, not only the collection and diffusion of useful information, but the exciting a general spirit for its advancement. From the processes above described, it is evident, that there is hardly any soil, however barren, which may not be rendered in some degree productive; and under judicious management, its fertility may be periodically even increased. With such means at our command, with such a foundation of national prosperity, as an improved system of agriculture furnishes, there can be no doubt, that the subjects of this realm, if wisely governed, may enjoy all the necessaries;—most of the comforts;—and many of the innocent luxuries of life.

CHAP. IV.

OF THE VARIOUS MODES OF OCCUPYING LAND.

INTRODUCTION.

THE principal articles of food, and the chief materials of human industry, are obtained from the soil. In order to procure them, it is necessary for man to exert both his active powers, and his intellectual faculties. By means of these exertions, he is enabled to raise a greater produce from the soil, than is requisite for the sustenance and accommodation of those who are employed in its cultivation. Unless a surplus produce both of food, and of the materials of industry be raised, society would remain stationary, and every species of improvement, in the condition of man, would cease. It is therefore a most important subject of inquiry, "How the greatest surplus produce may be procured, by a "judicious management of the surface of the earth?"—There are four modes by which this can be effected:—

1. Cultivating land for arable crops.
2. Appropriating it to herbage.
3. Employing it as a garden or orchard;—and,
4. Dedicating it to woods and plantations*. Each of these modes shall be briefly considered.

* Gardening, and the management of orchards, woods, and plantations, are essential branches *of agriculture*, taken in its *more extensive sense*; and cannot, therefore, with any degree of propriety, be left out, in *a general Treatise on the subject*, though many practical farmers, are not aware of their importance.

PART I.

ON THE CULTIVATION OF ARABLE LAND.

In discussing this subject, the two great points to be inquired into are; 1. Those operations of husbandry which take place, from the ploughing and ridging of the land, until its produce is ready for delivery; and,

2. What rotation of crops is best adapted for different soils and situations, more especially those, which furnish the greatest quantity of produce, without exhausting the soil?

I.

On the Operations of Husbandry in the Production of Crops, and in preparing the Produce for Market.

Previous to the commencement of arable operations, it is necessary, 1. That the soil be cleared of any substance which might either obstruct its cultivation, or become detrimental to the crop;—2. That it be of a texture or degree of openness favourable to the growth of plants;—and, 3. That it possess fertility sufficient, for the production of those articles proposed to be raised on it. These particulars being arranged, the subequent operations may be classed under the following general heads:

1. Ploughing.
2. Ridging.
3. Scarifying.
4. Harrowing.
5. Rolling.
6. Choice of seed.
7. Change of seed.
8. Quantity of seed.
9. Preparing the seed.
10. Season for sowing.
11. Sowing (drilling included).
12. Hoeing.
13. Treading.
14. Culture, while growing.
15. Reaping.
16. Harvesting.
17. Threshing.
18. Dressing, or winnowing.
19. Improving the quality of grain.
20. Preservation till sold.
21. Accidents to which grain is liable.
22. Diseases of grain.
23. Straw.
24. Stubbles.
25. Gleaning.

Sect. I.—*Of Ploughing.*

The various benefits arising from good tillage, cannot be too much inculcated. By tillage, both the composition and the consistence of the soil are improved, and adapted to the nature of the different species of cultivated plants.—By its assistance, the manure and the seed are most advantageously deposited.—It is calculated to give considerable relief from surface-water, and undue moisture, by enabling the cultivator to extend the depth, and to adjust the surface of the soil*.—It can be employed to destroy almost all the varieties of weeds which lurk in the soil, either as roots or as seeds, bringing the former to the surface, and inducing the latter to vegetate.—By the same means, various tribes of insects, and their larvæ, (more especially if the ploughing is given before frost), are got rid of.—And by exposing the soil to the influence of the atmosphere, the decomposition of dead substances, and, at the same time, the growth of living plants, are promoted.—As all these important advantages are to be obtained by the operations of tillage, it is not to be wondered at, that skilful and experienced husbandmen, have, in all ages and countries, entertained the highest ideas of its utility†.

Indeed where tillage is imperfect, there can be no good husbandry. In one extensively cultivated district, it is stated as more than probable, that a third part of the crops collectively, on some of the best fields, is every year lost, *through the want of sufficient tillage:* nay, that perhaps, from one-fourth, to one-sixth part, of the produce of the arable lands *of the kingdom*, in general, *is lost*, from the same cause‡. This is a subject, therefore, that cannot be too minutely investigated. It is well known, that the horses of a good ploughman, suffer less from the work, than those entrusted to an awkward and unskilful hand; and that a

* Deep ploughing permits the surface-water to pass beneath the roots of the crop in winter, and admits the action of the air and influence of the season in summer; hence a powerful evaporation is carried on, which supplies the plants with moisture during the driest weather. After every ploughing, the earth exhales as much as after the most copious shower of rain.—*Curwen's Report*, p. 54.

† Coventry's Discourses, p. 73.

‡ Marshall's Gloucestershire, vol. i. p. 12. It is contended by Marshall, and others, that if the operations of tillage were better performed, it would add one-third, or at least one-fifth to the produce of the kingdom.

material difference will be found, in the crop of those ridges tilled by a bad ploughman, when compared to any part of the field, where the operation has been judiciously performed.

It will be necessary here to consider, first, the best mode of ploughing; and then, other particulars connected with that operation.

1. *Mode of Ploughing.*

The simplest, the most economical, and perfect mode of ploughing, *for general purposes*, is, by a swing-plough, with a pair of horses, and without a driver. In the sandy soils of Norfolk, a wheel-plough will run over more expeditiously, with a broad and thin furrow-slice, a greater extent of ground; but in loamy and clayey soils, wheels must always be an incumbrance, and occasion additional labour to the horses.

In working with the two-horse swing-plough, the off-side horse walks in the furrow already made; the near-side horse on the untilled land, the ploughman in the new furrow. His skill is proved, when there is no *baulking*, or portion of the land left untilled; and when the furrow-slice is completely turned over*. If the bottom of the furrows remain with pieces of land uncut, they preserve the thistles from destruction, and prevent the descent of moisture from above, to the open furrows left for carrying it off, and the land is consequently soaked with water.

2. *Form of the Furrow-Slice.*

There is great difficulty, in considering the operation of ploughing, to determine the width, and the depth of the furrow-slice, as it must vary, according to the object the farmer has in view, the nature of the preceding and succeeding crop, and other circumstances. The following table, will give some idea, of what is considered to be a proper size, in different circumstances, though it must be regulated, in almost every case, according to the nature of the soil that is to be worked :—

* General Report of Scotland, vol. ii. p. 344.

Table of Ploughing.

Nature of the Ploughing.	*Width.* Inches.	*Depth.* Inches.
First fallow furrow,	10	6-8-10-12
Second furrow ditto,	9	6-7
Third furrrow,	8	5½
Fourth furrow,	7	5
Seed furrow,	7	4
Oat crop from turnips,	9	4-5
Oat crop from clover ley,	9	5-6-7
Beans, when on one furrow,	9	6-7-8-9
Beans, if with a second furrow,	9	5
Barley, first furrow,	9	6-7
Barley, second furrow,	8	5
Barley, last furrow, or after turnips,	8	4
Potatoes, first furrow,	9	4-6
Potatoes, second furrow,	8	5

The following general rules regarding the depth of ploughing, are recommended to the reader's attention, as the result of much careful inquiry respecting this interesting subject.

3. *Maxims respecting the proper Depth of Ploughing.*

1. The depth which land should be ploughed, must in some measure be regulated by the deepness of the soil. On thin soils, more especially on a rocky substratum, the ploughing must necessarily be shallow; but when the soil, whether light or strong, will admit of it, a furrow ought to be given as deep as a pair of horses can accomplish; and it is occasionally advantageous, to plough it even with four horses, particularly at the commencement of every fresh rotation. 2. Deep ploughing is highly advantageous upon every soil, excepting those where the substratum is of an ochry sand*. In fact, shallow soils, with such a substratum, are scarcely worthy of being cultivated, unless in situations, where much alluvial compost, or short town manure, can be procured. 3. It is a general rule, never to plough so deep as to penetrate below the soil that was formerly manured and cultivated, excepting upon fallow, and then only, when you have plenty of lime or dung to add to, and

* This is called *Fox-earth* in Derbyshire.—*Report*, vol. i. p. 305; and *Fox-bench* in Cheshire. *Ditto.*—In Norfolk also, it is considered to be hazardous, to plough up the black retentive subsoil, so frequent in that district; but any soil, with a subsoil capable of being pulverized, may be gradually, and successfully deepened.

improve the new soil*. 4. When fallowing land, it is advisable, to go as deep as possible with the first furrow, by which the subsequent furrows will be more easily executed, thus exposing the soil to the winter's frost, and to the summer's heat: but should *a strong soil* be ploughed in spring, for a crop of oats, the furrow ought not to be deeper than five or six inches. 5. Deep ploughing is advisable on moorish cold soils, when they are first brought into cultivation, as it affords a greater scope for the roots of plants to procure nourishment, admits the superabundant moisture to subside from them, and prevents the summer drought from making an injurious impression on the growing crops: but where such poor soils are retained in cultivation, the depth of ploughing ought in some degree to be in proportion to the quantity of manure that can be applied†. 6. It is unnecessary to plough deeper, immediately before the seed is sown, than the roots of the plants usually extend; and as beans, clover, and turnips, (the tap-rooted kinds usually cultivated in this country), seldom send their shoots above seven or eight inches down into the soil, and the culmiferous species in general, not so far, it is probable, from these circumstances, that from seven to eight inches may be deep enough for all the purposes of ordinary culture.

Deep ploughing is not to be recommended: 1. When lime or marl has been recently applied, such articles having a tendency to sink, from their weight, and the moisture they imbibe. 2. Where turnips have been eaten off by sheep, on the land where they were grown. 3. When grass only two or three years old, more especially where it has been pastured with sheep, is broken up; because, owing to the extreme condensation of the soil, by the trampling of the sheep, a furrow, even of a moderate depth *to appearance*, will make the plough penetrate, below the staple that had been cleared, by the culture given during the previous fallow. By this means, myriads of the seeds of annual weeds are raised to

* When soils are deepened, lime should always be applied, to correct any noxious ingredients in them;—and putrescent matters, to give the soil an adequate degree of fertility. It is a mistake, to suppose, that deepening the soil, *renders a much greater quantity of manure necessary.* The most intelligent farmers do not think that more than from ten to sixteen per cent. additional, is required.

† This maxim the farmers of Flanders acted upon, gradually deepening their soil, as their manure was augmented. Mr. Young observes, that in poor *hungry* soils, some proportion ought to be observed, between the depth of a ploughing, and the quantity of manure annually spread.—*Calendar*, p. 510.

the surface, where they vegetate, and materially injure the crop cultivated, besides replenishing the soil with a fresh supply of their own seeds. In all these cases, from four to five inches deep will be found sufficient. And, 4. If land is infested with natural grasses, which generally run much on the surface, the first ploughing should not be deeper, than is necessary to turn up the roots of the grasses, that they may be destroyed. It is also necessary to observe, that where the substratum is of an unfertile quality, ploughing deep cannot be safely adopted, except the land is under the fallow process, so that the new soil may be exposed to atmospheric influence, and improved by calcareous and putrescent manures, which may then be applied with peculiar advantage.

It is now proper to give, a general view of the advantages of deep ploughing, a practice which slovenly farmers, and even those who in other respects merit a different character, too often neglect. Whereas those who have acquired superior skill in their profession, in order that they may be enabled to give a thorough deep ploughing, at the commencement of every rotation, keep such a number of strong ploughs, calculated even for four horses, as may be adequate to the size of their farms, by means of which the stiffest soil, may be cultivated, to the proper depth, whenever it is desirable.

4. *Advantages of Deep Ploughing**.

1. Bringing up new mould, is peculiarly favourable to clover, turnips, beans, and potatoes; and, indeed, without

* I have made many experiments in order to ascertain the advantages to be derived from deep ploughing, all of which have proved the benefit of the practice. Even in many instances, in which the subsoil brought up, was, (to all appearance), very unfertile, the surface-soil was much benefited. A very simple and curious circumstance led me into a knowledge of this fact. A tenant on the land, had made a pit of potatoes in an angle of a field, then a wheaten stubble: the pit was dug eighteen inches deep, and about twenty yards long, after being filled with the roots and well covered by the soil from both sides. On the potatoes being consumed, the wheaten stubble was sown with oats, including the angle as already described. This crop proved indifferent, except on the angle where the subsoil was thrown up, which was most luxuriant, and which retained its fertility for two years afterwards. In another case, when drains had been made to carry off the surface-water from a field sown with rape, all the plants which grew near to the subsoil thrown up in this operation, grew more luxuriant than those in any other part of the field. From the fertile effects which this subsoil produced, and from its adhesive nature, I conceived it to be a species of marl; but on trying its properties, found it did not possess any calcareous matter.—*Remark by Edward Burroughs, Esq.*

that advantage, these crops usually diminish in quantity, quality, and value. 2. Deep ploughing is likewise of great consequence to every species of plant, furnishing not only more means of nourishment to their roots, but, above all, by counteracting the injurious consequences of either too wet or too dry a season. This is a most important consideration, for, if the season be wet, there is a greater depth of soil to absorb the moisture, so that the plants are not likely to have their roots immersed in water; and in a dry season, it is still more useful, for in the lower part of the cultivated soil, *there is thus a reservoir of moisture*, which is brought up to the roots of the plants, by the evaporation which the heat of the sun occasions*. 3. By deep ploughing, also, the ground may be more effectually cleared of root-weeds of every description; in particular, it is the best mode of eradicating thistles. 4. By deep ploughing, animal and vegetable manures, which have a tendency to rise to the surface, are properly covered. This cannot be done by shallow ploughing, in consequence of which, much of the value of these manures is lost. And 5. By deep ploughing, a more abundant crop is raised, than can be got from a shallow furrow, and the crop is more equal over the whole field†. An intelligent farmer, indeed, after pointing out, that deep ploughing increases the staple of the soil, keeps the roots of the corn from being injured by wetness, and also enables the crop longer to resist drought, adds, "*I have ever found deep ploughing attended with good crops, when ridges, shallow ploughed, in the same field, were but indifferent*‡:" which seems a decisive proof in favour of deep ploughing.

* Deep soils are generally the driest in wet seasons, but in very wet seasons, they are thought to be the wettest, because they are the longest in drying.

† In shallow soils, there are very often great inequalities in the crop, and that in places of a field quite contiguous to each other.

‡ Mr. Parker, of Munden, prefers nine inches for the depth of ploughing, and he has practised that system for many years, on good loamy land in Huntingdonshire, as well as in the clay and flints of Hertfordshire. He never lost a crop by it, but has met with unvaried success; and he is clearly of opinion, that the propriety of deep ploughing, ought not to be made a question, but received as an admitted truth. *Herts Report*, p. 60.—The farming gardeners near London, act upon the same system, with great success. They plough to the depth of from ten to twelve inches for cabbages and other crops, with implements made on purpose, and with from six to eight powerful horses. *Communication from John Middleton, Esq.*—Mr. Marshall has known a succession of shallow ploughing farmers, beggared on a stiff-land farm; and their successors, by deeper tillage, make a farmer's fortune upon it. *Review of the Eastern Department*, p. 339.—Great caution however must be used, where the substratum is of an unfertile quality.

5. *Preparation for Deep Ploughing.*

In Kent, the farmers have a practice which merits the attention of their brethren in other districts, that of *broad-sharing* their wheat and other stubbles, as a preparation for pease and beans, and to enable them to plough deeper with more advantage. It is by means of a *broad-share*, or strong plate or hoe, with the ends a little thrown back, from 18 to 26 inches wide, having a staple in the upper surface, by which it is fixed to the plough. With this implement, the ground is cut to the depth of three or four inches, and the soil thrown into slight baulks, which is done at the rate of three acres per day, by three or four horses. These baulks are harrowed down, and all weeds and rubbish carefully carried off. After this operation, which is favourable to the destruction of weeds, and collects a great quantity of materials for the dunghill, it is not difficult to plough the land to any proper depth, and the raw bottom is turned up, and meliorated, by the winter's frost, and the succeeding summer's sun, where fallowing is practised*.

6. *Manner of laying the Furrow-Slice.*

In several districts in England, it is usual to lay the furrow-slice quite flat, and this is particularly the case where there are no ridges; but in Northumberland, and in Scotland, a contrary system is adopted. It is founded on this idea, that as two of the principal objects in ploughing are, to expose as much surface as possible to the influence of the atmosphere†, and to lay the land, so that the harrows may, in the most efficient manner, raise mould to cover the seed; these objects are most effectually accomplished, when the furrow-slice is raised with a proper shoulder, forming the angle 45. The depth of the furrow for that purpose, ought in general to bear a due proportion to its breadth, that is, about two-thirds, or as six inches deep is to nine broad‡.

* Communication from Mr. Gascoigne.

† This is most effectually done by the process called *ribbing*; but the leaving the lower part of the triangle untouched, where the field is only partially ploughed, is much objected to.

‡ This is the general, if not the universal opinion of the Scotch farmers. The angle 45 is strongly recommended in Bailey's Essay on the Construction of the Plough, in his Durham Report, p. 102, and in Brown's Treatise on Rural Affairs, vol. i. p. 219.

7. *Seasons for executing the Work.*

This must greatly depend upon the soil, and the state of the weather. In very dry light lands, it is advisable, that ploughing should be carried on in damp weather, particularly the last ploughing, and the sowing of the seed*. On the other hand, soils, of so retentive a nature, as to hold water much more in quantity than is useful to vegetation, ought to be ploughed in a medium state, neither wet nor dry. When perfectly dry, they will not plough at all, being so hard and tenacious; and if ploughed when wet, the land is ruined by poaching, and plastering; hard clods are formed, which it is very difficult afterwards to reduce; and a whole crop may consequently be lost. This circumstance, renders the cultivation of clayey soils so extremely difficult. It is highly advisable, when the season will admit of it, to plough before the winter sets in, more especially strong clays, for after the soil is saturated with moisture, it is so pulverized by frost, as to be put in a state peculiarly calculated for the reception of spring crops; and in Great Britain, where the winter is long, and the spring shorter than in many other countries, the operations of agriculture must be expeditiously conducted, thence it is necessary, to divide the labour of ploughing, as much as possible, between harvest, winter, and spring.

All corn stubbles, (which are without clover or other seeds), should be ploughed as soon after harvest as the other works of the farm can permit, and thus put into a state for receiving benefit from the winter frosts†.

8. *The Hours of Working.*

Where the arrangement of farm labour is properly regulated, plough-horses should always work two journeys or yokings in the day, except in the shortest days, when they are not unyoked, but have a feed in the field at noon, by which any loss of time, in travelling to and from the stable, is prevented. The plan of two yokings a day, is highly advantageous, though it does not seem to be understood in those parts of the United Kingdom, where it is the practice to go but one yoking a day, even in the longest days of

* Communication from John Middleton, Esq.

† In Middlesex, these corn stubbles, if tolerably clean, are frequently sown with tares.—*Communication from John Middleton, Esq.*

summer*. That practice probably originated in the common-field system, and still continues, though the land to be ploughed, is very remote from the farm offices. This is an additional proof, of the importance of having these offices in a central situation. In some districts, the farmers allow four horses for each plough, two for a journey of five hours in the forenoon, and the two others for five hours in the afternoon. This practice, which must greatly increase the expence of cultivation, cannot be too strongly reprobated.

9. *Extent done in a Day.*

This must vary according to the quality of the soil;—the width of the furrow-slice;—the depth of ploughing;—the length of the field or ridge;—and the season of the year when the work is performed. Some general idea, however, of the extent done, and of the time required to do it, may be given.

A pair of horses can plough, of a medium soil, a statute acre per day, in two journeys of nine hours in all, provided the soil is not obstinate and tenacious. That extent is ten chains long, and one chain, or 66 feet broad. There are 88 furrow-slices, nine inches wide each, in 66 feet, so that the horses ploughing a furrow-slice of that width, travel 11 miles in ploughing an acre, exclusive of turnings. If the turnings are equal to one-tenth, the horses actually travel 12 miles and 176 yards, in ploughing a statute acre†. In one day, that is very good work for two horses; yet is a very slow pace, when divided into nine hours' work. In a dry fine soil, and on level ground, a pair of good horses will plough twelve chains; on wet heavy land, nine; but sometimes not more than eight chains. In crossing or stirring turnip land, in summer or spring, they will do sixteen chains, and in some very fine land two acres. The common day's work in Norfolk, is from an acre, to an acre and an half‡. In that district, the horses generally travel at the rate of three miles an hour§, and the draught is so light, as to be but little felt by the animals.

* Warwickshire Report, p. 67. When ploughing two yokings, the horses must be less fatigued, as post-horses, when driven 30 miles in a day, are better to perform their work in two stages, than in one.

† Husbandry of Scotland, vol. i. p. 225; Leicestershire Report, p. 87.

‡ Kent's Norfolk, p. 37.—Marshall says, that the common day's work, except in wheat seed-time, is two acres; a fact, he adds, which nothing but actual observation could have taught him to believe.—*Norfolk*, vol. i. p. 139.

§ Marshall's Norfolk, vol. i. p. 139.

A gentleman who has paid much successful attention to several branches of husbandry, calculates, that the number of yards travelled in ploughing an acre and a half, with a furrow-slice of nine inches, is - - 29,040 yards.
——————— eight ditto, is - - 32,640 ditto*.

The following tables are given from the same authority, founded on the above principle of calculation.

Tables, shewing the Quantity of Ground ploughed, according to the different Breadths of the Furrow-Slices, and the Rates of the Horses walking.

Breadth of the Furrow-slice.	Rate per Hour.		Length of Way travelled in ploughing.	Quantity of Ground ploughed.		Breadth of the Furrow-slice.	Rate per Hour.		Length of Way travelled in ploughing.	Quantity of Ground ploughed.	
Inches.	Miles.	Furlongs.	Yards.	Roods.	Poles.	Inches.	Miles.	Furlongs.	Yards.	Roods.	Poles.
8	1	—	14,144	2	24	8	2	—	28,168	5	7
9	—	—	14,157	2	37	9	—	—	28,193	5	33
10	—	—	14,148	3	11	10	—	—	28,188	6	21
11	—	—	14,157	3	22	11	—	—	28,215	7	5
The rate of walking, being one Mile and half a Furlong.						The rate of walking, being three Miles.					
8	1	½	14,960	2	30	8	3	—	42,296	7	31
9	—	—	15,004	3	4	9	—	—	42,350	1	30
10	—	—	15,012	3	19	10	—	—	42,336	9	32
11	—	—	15,048	3	32	11	—	—	42,273	10	27
The rate of walking, being one Mile four Furlongs.						The rate of walking, being four Miles.					
8	1	4	21,216	3	36	8	4	—	56,336	10	14
9	—	—	21,120	4	14	9	—	—	56,386	11	26
10	—	—	21,168	4	35	10	—	—	56,376	13	2
11	—	—	21,186	5	14	11	—	—	56,430	14	10

* Communication from J. F. Erskine, Esq. of Mar, in Scotland.

It is supposed, that in England in general, the common breadth of the furrow-slice, is about nine inches; but the generality of the farmers in Norfolk, for various reasons, prefer having their furrow-slices full eleven inches broad*; so that the quantity of the ground stirred in the same number of hours, worked by them, must be considerably more, than farmers in other districts can do, where the nature of the soil requires, to have the furrow-slice of a narrower breadth.

The effect of short ridges, and consequently of frequent turnings, is most strikingly exemplified, in the following table, drawn up by the gentleman formerly alluded to, from actual experiment.

Names of Fields.	Length of Ridges.	Breadth to give an Acre.	Breadth of the Furrow-slice.	Numbers of Furrows in the Acre.	Time it takes in turning.		Time taken up in stirring the Soil.		Number of Hours in the Day's Work.	
	Yards.	Feet.	Inches.		H.	M.	H.	M.	H.	M.
7. South Gubber, ...	78	186	8	279	4	39	3	21	8	0
3. East Loch, ...	149	98	—	147	2	27	5	33	8	0
11. Harperhill, ...	200	73	—	109	1	49	6	11	8	0
2. South Muir, ...	212	69	—	103	1	43	6	17	8	0
17. Long Bog Croft, ..	274	53	—	79	1	19	6	41	8	0

Thus it appears, when ridges are 78 yards in length, that no less a space of time, than four hours and thirty-nine minutes, is spent in turnings, in a journey of eight hours; whereas, when ridges are 274 yards long, one hour nineteen minutes is sufficient, in the same length of time. What then must the waste of time be, in small paddocks, and when four, or perhaps five horses are yoked, one after the other?

10. *The Expence.*

The cheapest ploughing, in any part of the United Kingdom, is upon the light lands of Norfolk. It was formerly

* A furrow-slice of this great width, will always be completely turned upside down.

as low as from 3*s.* to 4*s.* per acre; but now, two horses and one man, cost the farmers at the rate of 9*s.* per day; hence, as they generally plough an acre and a half a day, the expence is about 6*s.* per acre. But when ploughing is done by hire, the contractor finds every thing, and charges on an average 8*s.* per acre*.

The expence of ploughing in Scotland, from the difference of soil, and the greater depth to which the operation is carried on, is higher than in Norfolk. A ploughman, with a good pair of horses, properly fed, including the expence of the plough, the harness, &c. must, on an average, cost the farmer about 115*l.* per annum; and deducting from the year, 52 Sundays, and allowing other 13 days to be lost on different accounts, and supposing the team to be constantly employed, the expence of ploughing one acre, averaging the different states of the soil when ploughed, and the different objects in view, cannot be estimated at less than 8*s.* 6*d.* and in many cases it exceeds that sum.

By an experiment made in Oxfordshire, it appeared, that with four horses, an acre could not be done under 14*s*†.

In Derbyshire and Kent, the cost is from 12*s.* to 15*s.* per acre‡, and in many cases, 17*s.* In the latter county, from four to six horses are employed, to plough even a loamy soil.

But it is in Middlesex, where the most expensive system of aration is carried on. There, four horses at length, at 14*s.* per day, a man at 2*s.* 6*d.*, and a driver at 1*s.*; total 17*s.* 6*d.* plough so little, that the expence is estimated at more than 21*s.* per acre§.

Wherever two horses only have been employed to work in a plough, the circumstances of the farmers have greatly improved, owing to the expence of cultivation being so materially diminished. This ought to be a strong inducement, with gentlemen of landed property, to introduce upon their estates, the practice of ploughing with only two horses, and of going two journeys a day‖. The prohibition

* Communication from Mr. Blaikie at Holkham, in Norfolk. They frequently change their horses in the middle of the day, and then plough from an acre and a half, to two acres, with the same plough and ploughman. In the heavy part of Norfolk, the quantity is only about an acre per day.

† In one instance specified in the Middlesex Report, p. 130, the expence is estimated at 27*s.* per acre, for one bad ploughing; but that is a singular circumstance.

‡ Marshall's Norfolk, vol. i. p. 143.

§ Middlesex Report, p. 104.

‖ It is only within these few years, that the farmers in many parts of Ire-

of long teams, unless in particular cases, would not only be a real improvement, but would ultimately produce an increase in the rent-rolls of those proprietors who established so useful a system*.

11. *Cross-Ploughing.*

Though ploughing must in general be lengthwise, yet crossing the ridge is occasionally advantageous; sometimes to secure the complete stirring of the soil;—sometimes to promote the intimate intermixture of the manure, after a crop of drilled turnips;—and always, when the ground is summer fallowed. The celebrated Tull recommended, not to plough across the land, till the third furrow was given†, and this recommendation, is generally followed by farmers on clay soils‡. The head-ridge cannot well be cross-ploughed, but it should be done first, whenever there is more than one ploughing. If then neglected, it gets only one stirring afterwards, and the produce is inferior to what it would otherwise have been, not being so well pulverized.

12. *Trench Ploughing.*

The plan of ploughing double furrows, either by a plough with a skim coulter, or by means of one plough following another, though not often practised, is an excellent mode of breaking up grass land. The first plough pares off the surface from one to two inches thick, and turns it into the bottom of the last made furrow; while the second plough, going three or four inches deeper, turns upon it a sod of friable earth, which, being destitute of fibrous roots, harrows to a fine mould with little difficulty. The additional expence, on common occasions, is only 6*s*. per acre, which, in breaking up old swards, on clayey soils, is almost saved in the expence of harrowing; but where two additional horses and a driver are necessary, the extra cost will be from 7*s*. to 10*s*. per acre.

In trench ploughing, it is, in general, necessary, not to

land have been convinced, that strong soils can be effectually worked, by two horses, and a well-constructed plough; but latterly, seldom more than this number is used for this purpose, except when summer fallowing strong soils.

* Observation made by Mr. Middleton.

† Horse-hoeing Husbandry, 2d edit. p. 43.

‡ Mr. Middleton observes, that where ridges are broad and high, this beneficial operation is prevented.

go beyond the usual depth, but merely to separate the vegetable mould, or cultivated soil, from the lower stratum*. But in the sandy districts of Wiltshire, it is not uncommon, when a second plough follows in the furrow of the first, to go so deep as to throw up new soil, and to bury that which is supposed to be exhausted. This is done likewise in many parts of Devonshire, and is the same system, which, in Flanders, is executed in sandy soils, by manual labour. It is particularly desirable, to have such an extra depth of good soil in reserve, to be turned up, when the surface indicates exhaustion. Where the subsoil, however, is of a bad quality, it is not advisable to go so deep†.

13. *Ploughing-Matches.*

From the great importance of good ploughing, every means should be thought of, to extend a practical knowledge of the art; and no plan has been found more effectual for that purpose, than the establishment of ploughing-matches, and thus exciting a competition among ploughmen, by rewarding those who excel‡. At such meetings, farmers have beeen instructed, when they only came to be amused; their prejudices have worn away; and they have been induced to try new instruments of husbandry, and new modes of culture. Were it possible to impress upon the minds of farmers in general, the great importance of good ploughing, more especially the advantages of using ploughs with two horses, without a driver, and to make them sensible of the benefits of deep ploughing; the expences of cultivation would be diminished, and several millions in value, would be added to the produce of the United Kingdom§.

* Communications to the Board of Agriculture, vol. iv. p. 147.

† Wiltshire Report, p. 52.

‡ In Ireland, the various ploughing-matches, encouraged by the Farming Society, have been a chief means of forwarding the improved agriculture of the country.—*Remark by the Rev. Thomas Radcliff.*

§ This benefit might be obtained, were proprietors to resolve not to let their land to any one, who did not become bound, to use improved swing-ploughs, and, unless in particular cases, worked by two horses. It is said, that *in the infancy of good ploughing*, it is a great object, to have, by means of wheels, a number of ploughs, upon the same farm, correctly worked by unskilful boys, under the guidance of one good workman to regulate the irons.—*Remark by the Rev. Thomas Radcliff.*—But they will soon learn to plough, without the appendage of wheels, under a skilful and *willing* overseer.

Sect. II.—*Of Ridging.*

The next point to be considered is, the utility of having the land divided into ridges, and where that is judged expedient, the form in which they ought to be made.

Dry soils, being deficient in moisture, ought to be tilled flat, as any sort of draining, which the furrows might afford, would be prejudicial rather than advantageous. In Kent, dry land, cultivated by the common turn-wrest plough, is left as level as if it were dug with a spade. The moisture is thus equally diffused, and retained under the surface of the earth. This practice is likewise thought to be convenient to the operations of the mower, (much of the crop being there cut down by the scythe);—it is also favourable for the conversion of arable land into grass;—and it effects a considerable saving of labour*. The plan of cultivation without ridges, is sometimes done by going round and round a hill, from the circumference to the centre, or from the centre to the circumference. This mode requires little more force than common ploughing; it is likewise an expeditious mode, as there is no occasion for turning, and is economical, as by it every inch of the soil is moved†. But ridges are essential in wet soils and climates‡, operating as open drains, without the assistance of which, the crops would be rarely productive in rainy seasons. It is therefore, of much importance to the farmer, to be fully master of the rules, by which ridges can be formed to the best advantage. These may be considered under the following heads: 1. The

* Kent Rpeort, p. 65.

† Kames's Gentleman Farmer, p. 73.—Where it is wished to have no interfurrows, the best mode is, to plough the land in broad level ridges, and then to fill the interfurrow, by going once round it with the plough. The ridges direct the sower, &c. and yet the land, when harrowed, is left quite flat.

‡ Lord Kames is of opinion, that though clayey soils should in all cases be ridged, yet loamy soils should be tilled flat in a dry country, but ridged in a wet one, high or low, according to the degree of moisture and tendency to clay. *Gentleman Farmer*, p. 73.—There is a peculiar mode of forming arable land in some parts of Flanders, in particular, the "*Pays de Waes*," which it may be proper to describe.—The fields are small, usually about seven or eight English acres, and the whole ground is raised in the middle, gradually sloping to the ditches, into which the water naturally descends, the soil being of a sandy quality. These fields are called "*Terres Bombes*." They were formed by the spade, the digging commencing in the centre, and the earth being thrown upwards. It is singular to see a whole district full of these little hills or eminences. The fields are in general surrounded with trees, whose roots expand themselves in a lower stratum than the roots of the grain.

proper length of ridges; 2. Their breadth; 3. Their straightness; 4. Their height; and, 5. The proper line of direction, when the ground is steep.

1. *The proper Length of Ridges.*

The length of a ridge must vary according to the size of the field;—the acclivity of the ground;—and the nature of the soil, whether wet or dry.

In fields with much acclivity, ridges of about 150 yards, (7 chains), are found to be of a convenient length. A longer ridge, in such situations, tends to fatigue the horses; and if much rain or snow should happen to fall on sloping land, recently ploughed, the finest particles of the soil, and the most valuable parts of the manure, will be washed out of the ground, and conveyed, along the furrows, with too much facility, by a long run, to the headland, or to the nearest brook or river.

In wet soils, where the ground is flat, a ridge from 240 to 300 yards, (from 11 to 14 chains), may be considered as the proper length. If its exceeds 300 yards, the water may not easily get away, or it may be necessary to form a head-ridge across the field, so as to form a level for carrying off the extra moisture;—or, at any rate, to make *grips*, or small open cuts, in the lowest parts of the field, to collect and convey the water to the ditch.

In soils of rather a dry nature, and where the land is level, the ridge may be still longer; though, on the whole, a ridge from 350 to 400 yards, (from 16 to 18 chains), seems to be the preferable length, when circumstances are suitable. If it exceeds the latter size, horses are apt to be fatigued, from going so long on a stretch; and the loss by turning, when the ridge extends to 350 yards, is not considerable. Besides, when the ridge is very long, it is not only sown with more difficulty, but it has a tendency to discourage the reapers, when employed in cutting it.

2. *The Breadth of Ridges.*

Few subjects in husbandry, have occasioned a greater diversity of opinion, than the breadth of ridges. The reasons urged in favour of the different sizes, shall therefore be assigned, and the reader left to judge, from the statements laid before him, which is most suitable to the soil he cultivates.

In poor, clayey, wet soils, it is maintained by many intelligent farmers in England, that the ridges should be made only from three to six, or, at the most, seven feet broad; that on wet soils, small ridges keep the soil moderately dry; and that on thin soils, the staple is increased, by putting the earth of five feet upon four, while the produce is as great, as if the whole land had been under crop. Plants, they contend, are more uniformly healthful, from the freer admission of air, and ripen more equally on narrow, than on broad ridges. There is an advantage also, in cutting down the crop, as each reaper may have a separate ridge*.

A variety of ingenious arguments have been urged, in favour of ridges, varying in breadth from twelve to fifteen feet. It is said, that they are easily kept dry;—that the furrows are not apt to be rendered bare;—that the seed can be sown at all times, even with an adverse wind, at once going about;—that two harrows, going once about, completely cover the ridge; and that this is a proper proportion or breadth for three reapers.

On the other hand, the farmers of East Lothian, where this subject has been particularly studied, prefer ridges of eighteen feet, which they consider to be, not only better calculated, for preserving the land from receiving injury by wetness; but also, as tending to facilitate the several processes of dunging, sowing, harrowing, and reaping. Indeed, where the soil is deep enough to admit of three gatherings from the flat, without sustaining injury, they are of opinion, that a breadth of twenty-four feet will be found useful in wet soils.

The practice in various parts of England and Scotland, respecting the breadth of ridges, on wet soils, is so totally at variance, that it is supposed to be partly attributable to difference of climate. In Scotland, it is thought, that narrow ridges, unless there is an acclivity, soon become wet and poachy, and are long in getting dry; the rain that falls, remaining in the interfurrows, and soaking into the ground;—that the crowns cannot be raised sufficiently high, to be of much use in draining;—that turning the horses *short*, at the end of narrow ridges, is attended with difficulty;—that the loss of ground, by such a number of furrows, where no plant can properly vegetate, is enormous;—and that it is

* These were the sentiments of that eminent Norfolk farmer, the late Mr. Money Hill.

proved by experience, in climates more rainy than the southern districts of England, (namely, in the Lothians), that the strongest and most retentive soils, are kept perfectly dry in ridges, when properly rounded, of from eighteen to twenty-four feet in breadth.

In opposition to these doctrines, it is contended, that broad and high ridges are not favourable to the useful operation of cross-ploughing;—that they cannot well be harrowed by horses walking in the furrows, which is an advantageous practice;—that they are not well calculated for the drill husbandry;—that when ridges are narrow, the crowns may be so well raised, that no rain can lodge upon them; and that every possible objection to narrow ridges, on the score of wetness, is obviated, where *hollow-draining*, as practised in Essex*, is adopted;—that the furrows are not lost, acting not only as drains, but admitting much air;—that no inconvenience can arise by any length of furrows, to a field ploughed in very narrow ridges, if proper use be made of grips;—that where the ridges and furrows are sufficiently narrow and numerous, the soil cannot be washed away;—and as a general maxim, it may be laid down, "*that as in dry porous soils, the ridges cannot be too broad, so in wet clays, they cannot be ploughed too narrow.*"

From these adverse statements, the reader will be able to judge, what size of ridge, will best suit his soil, and climate.

In regard to dry, porous, turnip soils, it is of little importance, whether ridges are formed at all, unless to regulate the sowing and cutting down the crop. A thirty feet ridge is, in such cases, considered to be a proper width, as it saves time in ploughing, having fewer furrows to clear out in finishing the field: it also saves time in forming the ridges, when the land has been cross-ploughed; and it keeps more moisture in the soil, than ridges of a less width.

The peculiar mode which has been put in practice, by an intelligent farmer in Scotland, (of having covered drains in the furrows of broad ridges), would probably be of use, in several districts of England; particularly in the Vale of Gloucester, as in wet seasons, and more especially in winter, each furrow, where these broad ridges are used, becomes a

* In Suffolk and Essex, where hollow-draining is universal, the ridges are two *bouts*, or four furrows of the plough, when land is fallowed. By the hollow-drains, every objection on the score of wetness, is removed, but it is a very expensive operation.—*Communication from the late Arthur Young, Esq.*

canal of stagnant water*. The farmers in that Vale, have so far adopted the plan above recommended, as to plough a small ridge between the high ones; and they have nothing to do, but to put a hollow drain under these small ridges, in order to effect a most important improvement. The following Sketch will give some idea of the nature of the operation:

The drains are generally about two feet and a half deep, and as narrow at the bottom, as an ordinary spade can conveniently work them. They may be filled with bricks, or small stones, to the depth of rather more than a foot, and covered in the usual manner with straw and earth.

It is evident, that in addition to every other consideration, the breadth of ridges, must also depend upon the mode of culture. Where the broad-cast system is followed, the size must be calculated, for enabling the sower to scatter the seed equally over the land†. Whereas, when the drill system is adopted, the breadth must be adjusted to the size of the machine. In wet or tenacious soils, it is an excellent plan, to make the horses walk in the furrows, and to drill a whole ridge at once.

3. *Straightness of Ridge.*

It is extremely material, to have the ridge as straight as possible. It is the very essence of good ploughing, to hold the plough even, which it never can be, if it has to work in a curve. Besides, ridges, when very crooked, measure more in the serpentine direction, than when taken in a straight line, and consequently they must require more labour in ploughing, harrowing, &c. than if they had been perfectly straight. That does not imply, that there is more land in the field; but an improper form, by impeding operations of the plough, materially tends to augment the

* Marshall's Gloucestershire, vol. i. p. 79.

† It is said, that a good sower, will scatter the seed sufficiently correct, in ridges of any breadth; but such sowers are not always to be met with.

labour. Every farmer knows, by experience, how awkwardly the plough moves in such ridges, and that in finishing them, there must be much more turning. Where the ridges, also are irregular, or broader at the one end than the other, a considerable waste of seed is likely to be the consequence; for the seed cannot possibly be scattered with the same regularity, as if the ridge was altogether of the same breadth*.

In regard to crooked ridges, straightening and levelling them, in very stiff wet clays, is a very difficult operation, and unless executed with considerable judgment and skill, will be productive of some temporary loss. It should never be attempted, but in a year of fallow, and the straightened land, should be supplied with considerable quantities of calcareous and enriching manures, and much cross ploughing, to mix the old and new staple, and to rouse the fertility of the new soil.

4. *Height.*

It is necessary that ridges, on wet land, should be well rounded, so as to form the segment of a circle, without being carried to so ridiculous an extreme, as is the case in Gloucestershire, where two men, standing in the furrows, cannot see each other's heads†. For the purpose of elevation, the soil is gathered, in the course of ploughing the ridge, once or twice, according to its dryness or wetness. Indeed, in very wet lands, the soil has often been gathered thrice, with much success, especially for a spring crop; for this mode, not only lays the land dry through the winter, but enables the farmer to commence his operations sooner in the spring. The height, however, should not be too great; only sufficient to furnish a declivity to let off the water; for when the crown is raised too high, one-half of

* Donaldson's Modern Agriculture, vol. ii. p. 267.

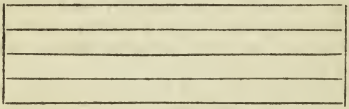
† The high ridges of the Vales of Evesham and Gloucester, have long been proverbial. They are often from 15 to 20, and even 25 yards wide, and from four feet, to four feet three inches, and sometimes more in heighth; but eight yards wide, and from two to two and a half feet high, is the favourite size. Even a ridge of these dimensions, however, is more steep-sided than is necessary. These masses of earth, were probably accumulated, in order to render the land dry; but they cannot be too severely reprobated, since the art of draining has been so much improved. See Marshall's Gloucestershire, vol. i. p. 75; Rudge's Gloucestershire, p. 105. When ridges are high in pasture lands, sheep are apt to fall upon their backs between the ridges: but this rarely happens but in moonlight nights, for in dark ones they never stir.

the ridge is often covered from the sun, (a disadvantage which is far from being slight in a cold climate), and the crop, which is always best on the crown, is more easily shaken by the wind, than where the whole crop is of an equal height*. Besides, with high ridges, there is a tendency to work the fertile soil to the centre, and to leave the rest of the land very bare, and consequently deficient in produce. There cannot be a worse error in tillage. But it may be remarked, that the height of a ridge by gathering, entirely depends upon the deepness of the furrow slices; for some farmers, by two gatherings, will raise the ridge as high, as others will do by three.

5. *Line of Direction.*

The last point regarding ridges, which it is necessary to consider, is, the line of direction, more especially in steep grounds. There are four modes in which the ridges may be laid out, on such declivities.

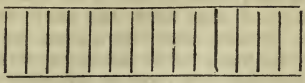
1. *When they are planned on the same Line or Level, thus:*



This is done partly with a view of preventing the soil and manure from being washed down, and partly from the idea, that it is easier for the cattle to work it. But unless the subsoil is porous, it detains the water in the furrows. It is likewise an awkward mode of cultivation, if the common plough is used; and if a plough with a shifting mouldboard, (usually called a *turn-wrest* plough), is employed, it always throws the furrow-slice down hill, and consequently brings, lower and lower, the staple of the soil.

* Gentleman Farmer, p. 74. From about three to four inches in height per yard in width, is considered a proper height. In spring crops, oats are better on flat land than barley, the ordinary varieties of oats requiring more moisture than those of barley.

2. *When the Ridges are straight up and down.*



This is objected to on the ground, that the soil and manure are both apt to be washed down, and when the plough is going up the declivity, the earth makes such a resistance, that the cattle have great difficulty in dragging the plough up the hill.

3. *From the top of the Bank sloping to the left.*

This mode also does not answer, for when the plough is going up, the ploughman has to force the earth against the hill, which makes but very imperfect work; and it does great injury to the cattle.

4. *From the top of the Bank sloping to the right.*

When the ridges are laid in this manner, the horses have a better footing, and the ground always falls from the plough, as it goes upwards, without any great exertions on the part of the ploughman or the cattle. By this plan, no part of the soil is forcibly turned against the acclivity; but it is so contrived, that, on returning down the hill, the furrows fall freely from the plough, and thus every inch of the soil is perfectly turned over. These diagonal ridges, are likewise extremely favourable to the cartages of both produce and manure. If there be soil enough, any ground, however steep, may be cultivated on this principle, *and by this mode,*

land may be ploughed, which would otherwise be impracticable.*

On this subject, it is farther to be observed, that the ridges should be directed north and south, if the ground will permit. By this means, the east and west sides of a ridge, have the influence of the sun equally divided between them; and the crops they produce, will ripen at the same time†.

Sect. III.—*Of Scarifying, and putting in Crops without Ploughing.*

It is remarked by an eminent author, that if one ploughing to the full depth be given, once in 12, 18, or 24 months, shallow tillage afterwards, by scaling, scarifying, scuffling, skimming, or broad-sharing, is, in many cases, preferable, to frequent deep-working, and especially for wheat, which loves a firm bottom‡.

This doctrine, if not carried to an extreme, is, *in particular cases*, entitled to the attention of the practical farmer.

It appears, that the system of sowing upon the winter furrow, was adopted in Scotland many years ago, and was strongly enforced by Lord Kames, in his Gentleman Farmer, printed an. 1776. He there proposed, that the surface should be pulverized by a strong harrow, the scarifier or grubber being then unknown in the Lothians§.

The practice of sowing on the winter furrow, both oats and barley, has been followed with much advantage, in the

* Some farmers, where the field is very steep, plough only down hill, the plough being drawn up empty; but this is hardly ever necessary, if the fourth plan is adopted. Where the declivity *is very considerable*, it is questionable whether the land ought to be ploughed at all, the soil is so apt to be washed down the hill.—(See Statistical Account of Scotland, vol. ii. p. 142, note).

† Gentleman Farmer, p. 79.

‡ Young's Calendar, p. 510.

§ "The preferable method for sowing oats, and especially in a clay soil, is to turn the field over after harvest, and to lay it open to the influences of frost and air; which lessens the tenacity of clay, and reduces it to a fine mould. The surface soil, by this means, is finely mellowed for the reception of the seed; *which it would be a pity to bury, by a second ploughing, before sowing.* We are taught by experience, that this soil, ploughed before winter, is sooner dry, than when the ploughing is delayed till spring; and as early sowing is a great advantage, any objection, on account of the superficial crusting, is easily removed by a strong harrow, which would produce abundance of mould for covering the seed.—*Kames's Gentleman Farmer*, p. 95 and 96.

counties of East Lothian, Kincardine, Dumfries, and Roxburgh, and the crops have always been more certain, and much more abundant, especially when a dry spring and summer took place. It thence evidently appears, that ploughing lands in spring, when sufficiently clean, and prepared before winter, is an unnecessary increase of labour, for oats, and in many cases for barley*; that turning up a clay soil, at that season of the year, is a dangerous and precarious operation; and that all the advantages of a fine mellow surface, which cannot be regained after a spring ploughing, are lost. There is also the risk of rain during the operation, which, in many instances, puts the land so much out of good condition, as to render the chance of a crop very precarious.

The farmers in the Carse of Gowrie, however, do not think the system applicable to their *strong soils*. They are of opinion, that it is impossible to keep the ground clean, and in such good order for a succession of crops, *without spring ploughing*. The scarifying system, however, goes upon the idea, that the ground upon which either barley or oats is proposed to be sown, has been previously cleared of weeds, either by a summer fallow, or by some cleansing crop, as beans; and did not depend upon any process to be administered, in the course of that very spring on which the grain crop was to be sown.

The scarifier, with some improvements, being now established in the Lothians, under the name of "*grubber*," there can be no doubt, that so beneficial a practice will spread, as much as the nature of the Scotch system of husbandry will admit of it, where oats generally succeed grass, which in backward seasons, cannot be got ploughed sooner than February or March; in which case, the plan cannot be adopted. In regard to the ground that has carried turnips, and has been fed with sheep, it has been found that scarifying is preferable to ploughing, for the succeeding crop.

With respect to England, it is maintained in several districts, that spring crops may be successfully sown without spring ploughing: that the land may be sufficiently stirred

* For potatoes or turnips, spring culture is considered necessary in Ireland. *Remark by Edward Burroughs, Esq.*—But the practice of spring sowing, without ploughing, has been adopted on strong land in some parts of Ireland, with great advantage; and the oat crop thus sown upon a retentive clay, will be a fortnight earlier, than that sown upon a spring ploughing.—*Remark by the Rev. Thomas Radcliff.*

and pulverized by the scarifier or scuffler*: that it is of very great consequence, to expose a strong clay soil to the winter frosts, (which can only be done by ploughing in autumn, or the beginning of winter), but the benefit of that practice would be lost, if that part of the soil were ploughed down, that had been meliorated by the frost and the atmosphere. They consider it as absurd to bury the dry friable porous surface, which the frosts have left in so favourable a state, and upon which, if rain falls, no plastering ensues, as it dries speedily, and remains in a porous state; but which, if ploughed in spring, is often so impregnated with moisture, that if worked, it plasters, and the north-east winds harden it like stone.

These opinions are strongly sanctioned, in various instances, on a great scale, and by the practice of a number of farmers in Dorsetshire†, Buckinghamshire, Norfolk, and more especially in Suffolk. The practice of scarifying, has become so predominant in the strong land district of that county, from the fine tilth it gives to the lands, that there is reason to believe, it will entirely exclude the application of the plough to heavy lands in spring. The management for this purpose, is excellent. While the land is yet dry in autumn, the fields are carefully ploughed into ridges, exactly of the breadth which suits the various implements to be employed in the spring, such as harrows, scufflers, scarifiers, and drill machines, all adapted to one given breadth, so that no horse, when drawing any of them, may ever set a foot on the ridge, but move solely in the furrows. This improvement is applicable to the broad-cast system, as well as to the drill; but it certainly removes the main objection to the drilling of spring crops on strong lands‡.

Nor is this practice of scarifying for a spring crop, solely applicable to a winter furrow, on strong lands, but it has

* It is likewise aerated, for in fine free soils, the scarifier enables the air to pass two or three inches below the surface of the soil.

† An experiment of the effects of scarifying, compared with spring ploughing, was tried in spring 1811, by Mr. Robert Roberts, of Gorewell, about seven miles from Bridport in Dorsetshire. He had a field of about forty acres of flinty loam, under a crop of broad-cast turnips, eaten off by sheep. Not being able to plough the whole field in time for a crop, he got a scarifier, and used it at the rate of about 12 acres a day, followed by the sower, and the harrow; four acres were ploughed, the rest were scarified. The crop was oats, and the scarified part was greatly superior to the ploughed, in the proportion of nearly one-third.

‡ Communications by the late Arthur Young, Esq. in the Husbandry of Scotland, vol. ii. Appendix, p. 66.—Mr. Middleton remarks, that this excellent practice is inconsistent with broad ridges.

likewise been tried, and most successfully, in autumn. Pea and bean stubbles have been scarified, and sown with drilled wheat, without any ploughing, and the crops have proved better than after the usual system*. In late and rainy seasons, sowing wheat after beans, is extremely precarious, but if this system uniformly answers, there is an end to that difficulty.

Some doubts are still entertained, whether, though the plan may succeed in regard to one crop, it may not injure the succeeding ones in the rotation. If that should be the case, it ought not to be persevered in. But from the best information that could be procured, in consequence of inquiries made expressly to ascertain that fact, there is no reason to apprehend, that the future crops will be thereby deteriorated†.

Sect. IV.—*Of Harrowing.*

This process is of essential use in the culture of arable lands. By harrowing, the soil is pulverized;—root-weeds near the surface, are torn out and collected, more especially during the operation of fallowing;—the manure that has been inserted in the soil, is more thoroughly mixed with it;—and the seed is more effectually covered‡. The large, or what are called the *brake* harrows, are of great use also in the cultivation of rough land§.

To answer so many various purposes, harrows of different dimensions, weight, and strength, have been invented, suitable to the strength and condition of the soil, and adapted to the particular purpose intended to be accomplished.

There are two modes of driving the harrows, either lead-

* Essex Report, vol. i. p. 420.

† In the Suffolk Report, Appendix, p. 350, there is an account of about twenty intelligent practical farmers, who have persevered in the practice for several years with success. See also Mr. Moseley's Letter to Sir John Sinclair, dated in April 1813, confirming that information. In Derbyshire, scuffling strong land is preferred to harrowing, the former loosening the soil, and exposing it to the sun and air, whereas harrowing tends to consolidate it.—*Report*, vol. ii. p. 48.

‡ Comparative trials have been made of the effects of harrowing for a barley crop; and the difference in favour of harrowing, was above 2*l.* per acre, while the expence was only three shillings. In regard to crops of wheat, however, sown before winter, an idea has become prevalent, that too much harrowing is detrimental. When the surface is rendered too fine and smooth, the plants are apt to be thrown out.

§ General Report of Scotland, vol. i. p. 217 and 360.

ing the horses, or driving them by whip-reins. The latter ought to be preferred, as the horses move with a quicker step, and the driver runs no risk of injury, while he is always at hand, to remove any obstructions that may occur, from the accumulation of weeds, and other extraneous substance among the tines, or by the harrows riding on each other*.

Harrowing is usually given in different directions; first in length, then across, and finally in length, as at first†. An excess of harrowing is prejudicial to wheat; it is better, for that crop to have the land rough and cloddy; but the process ought to be effectually done for barley, (more especially if accompanied by grass-seeds), and for turnips.

The quantity done must vary according to the pace of the horses. In Norfolk, it is the custom to walk the horses against the rise, if any, and to trot them back again in the same place. The quantity done in this way, is about seven acres per day‡. In Scotland, a man and a pair of horses, will do a single *tine*, as it is called, to the extent of ten acres; but if a double tine, only five acres per day. The expence in the one case is 10½*d.*, and in the second 1*s.* 8*d.* per acre.

As the treading of horses is injurious to the land, when in wet condition, attempts have been made, to discover a mode of harrowing, which might be performed by horses walking

* Brown's Treatise on Rural Affairs, vol. i. p. 276.—Some farmers prefer finishing heavy land by cross-harrowing, to facilitate the descent of surface-water from the crowns of the ridges, to the interfurrow.—*General Report of Scotland*, vol. i. p. 361.

† Young's Norfolk, p. 191. When done only once, they go over from 12 to 15 acres.

‡ General Report, p. 362. It is proper to observe, that, to a certain extent, the greater number of harrows, attached under the *same yokes*, the more work, in proportion, will be done; and of course the cheaper it is executed. A driver with one horse, and one harrow, makes an extremely thriftless operation; two horses, and two harrows are better; but three is the best mode of any; for more than three it is very difficult to manage. The reason why two harrows are better in proportion than one, and three than two, is, that a small piece of land, at the extreme diagonal corners of the space covered by the harrows, is insufficiently done, and must be overlapped the next time the harrows go round. This piece is to the same extent, when one harrow is used single, as when two or three are yoked together. Thus, when one harrow is yoked by itself, it will not sufficiently harrow more than two feet and a half. But two harrows together, will harrow six feet, and three will harrow ten feet and a half equally well. Each harrow, after the first, adds four feet to the space, properly harrowed. Hence, three harrows in a set, are better than four harrows separately, besides requiring only one driver, instead of four.—*Communication from Mr. George Robertson, author of the Mid-Lothian Report.*

in the furrows*. But where the ridges are broad, such machines are complicated and expensive, though, with narrow ones, they have succeeded; and this is one of the advantages which narrow ridges have over broad ones.

Sect. V.—*Of Rolling.*

An intelligent farmer maintains, that if draining is the first, manuring the second, and cultivation the third, that rolling ought to be considered the fourth principal operation in the processes of agriculture†. Its importance indeed is every day becoming more apparent, and new advantages are derived from its use, both on arable, (to which the inquiry is now restricted), and on grass lands.

Without rolling, the process of summer-fallow, on strong land, cannot be completely executed; but by its aid, the strongest and most obdurate clods may be reduced, and the harrows and the scarifier, are thus enabled to tear out the roots of the couch grass, and of other destructive weeds. How much cheaper is rolling, than the old practice, of breaking such clods by wooden mallets, or by large three-pronged forks, as is practised in some parts of Flanders! To facilitate this process, rollers, with spikes, and knives, (which are found more effectual), are sometimes used‡. Lord Kames recommended for that purpose, surrounding a wooden roller with circles of iron, six inches asunder, and seven inches deep, which would cut the most stubborn clods, and reduce them to pieces of a moderate size. In stiff clays, this may make the difference of a plentiful, or a scanty crop§. Others prefer the *drill-roller*, consisting of solid, wedge-like

* Bedfordshire Report, p. 278. General Report of Scotland, volume of Engravings, Plate 5, Figure 10.

† Essay on Rolling, by Mr. Christopher Morley. Comm. to the Board of Agriculture, vol. ii. p. 148.

‡ North Wales Report, p. 118.—Mr. Blaikie at Holkham, recommends, a double spike roller, as preferable to a single one, for the purpose of pulverizing strong soils. It is formed, by two rollers hung in the same frame, so close, that the spikes of one work through those of the other. It is a ponderous implement, not liable to be clogged; and literally grinds the soil. It is necessary to wind this roller up, when it turns at the end, or for safe conveyance from one field to another. This is done by a hand-rack fixed on the frame; the fulcrom, a pair of low strong wheels, attaches to the side of the frame.

§ Gentleman Farmer, p. 26. For this purpose a roller with sharp pointed darts, made either of forged iron, or cast metal, has lately been invented, which effectually reduces these clods. An Engraving of one is in the General Report of Scotland, volume of Engravings, Plate 6, No. viii.

rings of cast-iron, with a hole through them, to receive a stout wooden axis*.

In preparing every species of adhesive soil, for a spring or summer crop, in particular when barley, potatoes, or turnips are to be sown, rolling is essential†; but it is after the seed has been sown, that the greatest advantages are derived from the process. 1. Wheat should always be rolled in the spring, after frosts, as it makes the soil adhere more closely to the roots of the plants, encourages vegetation, strengthens the stems, and renders the grain more perfect. 2. When any crop of grain is sown with artificial grasses, rolling is particularly necessary, to make an even surface, bruising all clods, and pressing down any stones it may not be thought necessary to carry off, to facilitate the future operation of the scythe. 3. Oats, in a light soil, may be rolled with advantage, immediately after the seed is sown, unless the ground be so wet as to cling to the roller. 4. After turnips are sown in drills, they ought to be immediately rolled, to make the soil compact, and to promote their speedy germination‡. 5. Not only for turnips, but for all other crops, rolling, particularly a little after midnight, is found to be useful for destroying slugs§, snails, the wire-worm, and other vermin, so destructive to young plants. And, 6. Flax ought to be rolled immediately after sowing; it makes the seed vegetate equally, and prevents after-growth,

* Derbyshire Report, vol. ii. p. 46.

† It is improper to roll land before winter, for wheat. It is better that the surface should be lumpy and uneven.—In 99 cases out of 100, when the surface is too smooth before winter, the crop is hurt by the frost. Even when wheat is sown in February, the roller must be used with caution.

If the land lies rough in winter, in all probability, the water passes through it more freely, by which the plant is more effectually preserved dry; and it is well known, that strong soils are the more liable to become cohesive after being well pulverized, particularly if the operation is not performed when they are in a very dry state.—*Remark by Edward Burroughs, Esq.*

‡ A small stone, or wooden roller, is commonly used; but it is now ascertained by experience, that, on light soils, a heavy roller is much more effectual for the destruction of the fly, or rather beetle, which is thus either crushed, or so shut up in the ground, that it cannot extricate itself. *General Report of Scotland*, vol. iii. p. 406.—At the same time caution is necessary in using the roller on turnip-seed when the land is moist, and the soil is at all of an adhesive quality; as the seed is apt to adhere to the earth collected in the course of the operation. When the land is not perfectly dry, a few bushes tied together like a large broom, and drawn by a boy down the drills, is the most advisable mode of covering the seed, and it may be done at the rate of two acres per day.—*Remark by Edward Burroughs, Esq.*

§ Mr. Vagg of Chilcompton, was rewarded with several hundred pounds, for publishing an account of the means of destroying slugs by midnight-rolling. For the fly or beetle, day-rolling is more likely to be useful.

the mischievous effects of which are visible in every step of the process for dressing flax.

The other advantages of rolling arable land are, that it renders a loose soil more compact and solid. This encourages the growth of plants, by pressing the soil to their roots. It likewise keeps in the moisture, and prevents drought from penetrating. When the soil is worked up lightly, moisture either filters through it too quickly, or is easily evaporated. In a dry season this may occasion a very material difference in the crop, more especially in a light soil.

Rolling is executed to most advantage, across the direction of the ridges, because more adapted to ensure full benefit to the furrows, which otherwise may not be properly gone over.

The heavy roller, allowing for a slight overlap, and the time spent in turning, may roll about six acres per day, the expence of which may be from 1*s*. 9*d*. to 2*s*. per acre.

Farmers are rarely provided with a sufficient number of these implements. When a large field is to be rolled, a number of rollers ought at once to be set at work, otherwise an opportunity may be lost, never to be regained*; and where oxen are kept, they may be usefully employed in this operation.

Sect. VI.—*Choice of Seed.*

Cultivators often commit very serious blunders in the choice of seed; yet by attention to this object, they might frequently add considerably to the quantity of the produce, and to the intrinsic value of the crop.

By some, this hazardous rule has been recommended, that of taking the worst grain for seed; but it is a much safer system, unless in cases of real necessity, to save none, but what is fully ripened, for such seed is less affected by local circumstances, and unfavourable seasons. The ripest seed may be obtained by beating, or slightly threshing the sheaves. The shape of the seed merits attention, for though size or magnitude, is generally owing to the soil in which it has been grown, yet it is likewise a sign of its ripeness. In regard to figure, much depends upon the climate, for warm and early situations produce round grain; whereas a long figure denotes the reverse. Colour is a popular mark in some cases,

* Brown on Rural Affairs, vol. i. p. 279.

but is not itself of importance. It is prudent, however, to raise that sort, that is most suitable to the market, in regard to colour, and in other respects. Sometimes seed, apparently quite sound, is incapable of producing plants. This should be ascertained by sowing a certain number, and seeing how they spring.

On the whole, though blighted grain will often vegetate, and though it is possible, that in rich soils, and in very favourable seasons, it may produce even an abundant harvest; yet the prudent farmer, will not rely *upon the chance of such an event*, as a practice on which he ought to depend, more especially, when his crops are sown in winter, or early in spring, and consequently are exposed to much severity of weather*.

Care also must be taken, that the seed has not suffered injury, by being bruised, or having imperfect lobes, or broken husks, or that there is no risk of sterility from age†.

Where domestic seed is relied on, it is proper to change the seed from the heavier, to the lighter parts of the farm, and *vice versa*, if there be much difference. On clay farms in general, domestic seed may be safely used for some time; but with a view to prevent degeneracy, it is an excellent practice, to select, from the growing crops, the ears which are the soonest ripe, and which are of the plumpest quality; by this means, those husbandmen who devote themselves in a peculiar manner to this object, cannot only supply themselves, but can always command a much higher price

* After the miserable crops of 1782, some experiments were tried in Scotland, to fix, if possible, on some decided marks, by which good seed might be distinguished from such as was injured by frost. It was soon found by experience, that no stress at all was to be laid on the appearance of the grain in its natural state. In regard to oats, it was found; 1. That the clearest, and best looking oats, when sown, often produced the worst crop; 2. That the grain which yielded, when milled, the greatest quantity of meal, was far from having the best vegetative powers; and, 3. That because the grain sprung readily when put into a pot of earth, it could not, therefore, be depended upon for good seed; for it often sprung readily through the ground, without having strength enough to bring the plant to maturity. On the whole, it was found, that the best mark by which sound seed oats can be distinguished from such as are injured by the frost, was, to examine the grain, when stripped of the outer husk; and to consider that as the best seed, which, in that state, is plump, and clear, and free from shrivelling, and darkness of colour, more especially at the extremities. *Statistical Account of Scotland*, vol. iv. p. 550.—It has been found, that seed, when it has been much exposed to frost, will often never vegetate; that it does rise above the surface; above double the quantity is necessary; that it will not yield one-third of the produce of good seed, and that the quality is much inferior.

† Coventry's Discourses, p. 82.

than others, by selling the grain raised upon their farms for seed, either among their neighbours, or to be sent to other districts*.

Sect. VII.—*Change of Seed.*

A change of seed, is in general to be recommended, as founded on rational principles. Every species of grain has a climate adapted to it, where it flourishes,—where it grows to perfection,—and where it never degenerates.—In a country where wheat grows naturally, as in Sicily, seed dropping from the mother-plant, arrives at perfection, though neither the seed nor the soil be changed. But as wheat is not a native of Britain, it has here a great tendency to degenerate, more especially in the more northern districts;—and, *it degenerates rapidly*, if the seed be sown, year after year, where it was produced. Nor is it sufficient that the seed be taken from a different field, it ought also to be taken from a different soil, and from a different atmosphere†.

Besides preventing a degeneracy in the quality of the grain, the crops of the farmer, by a judicious change of seed, will sooner reach maturity; an object, in many cases, of the greatest moment. It is well known, that a change of constitution in plants, originating from the situation in which they have been placed, is commonly transmitted to their offspring.—Plants propagated from seed, produced in a warm sandy soil, will therefore grow fast in whatever soil the seed is sown; and plants from seed produced in a

* General Report of Scotland, vol. i. p. 373.

† Gentleman Farmer, p. 333.—Marshall's Southern Counties, vol. i. p. 120.—Farmers on the borders of Lincolnshire, make a considerable advantage, by purchasing their seed wheat from the Fens; they find the change useful, and at the same time save in the price.—The annual change of the different seeds, is found to be of great advantage, as the same seed, sown successively for years, in the same soil, becomes gradually small and unproductive. *Statistical Account of Scotland*, vol. viii. p. 337.—In Flanders, they never use the grain or seeds grown on the lands to be sown, nor regard the additional expence attendant on the purchase of seed that is heavier and more healthy. Their flax-seed they bring from Riga or Memel, and their potatoes from Brabant. *Vanderstracten's Improved Husbandry*, p. 51.—The Farming Society of Ireland, by its premiums, introduce the habit of sowing seed imported from England. By this means, the quality of the Irish grain is greatly improved, and the samples of corn now produced for sale at the Irish, would not disgrace any English market. *Remark by the Rev. Thomas Radcliff.*—English grain, sown in Ireland, generally comes to maturity ten days, or even a fortnight, earlier than the native seed under similar circumstances.—*Remark by Edward Burroughs, Esq.*—Potatoes produced in burnt land, produces the best seed of Irish growth.—*Ditto.*

cold stiff soil, are late of growing, even in a warm soil. Hence the advantage of changing seed from a warm to a cold soil; for though seed from a warm soil, will not grow so quickly in a cold, as in a warm soil, it will, however, always grow more quickly than seed from a cold soil*. The quantity also will be increased. From an experiment made by the celebrated Lord Kames, it would appear, that the produce of changed seed, exceeds that of old seed, at the rate of nearly twenty-six per cent†. The farmer, however, ought not to alter his seed, while it gives him fair and reasonable satisfaction, unless he has every reason to be convinced, that better can be obtained by a change.

It is proper to add, that in two cases, it has been found expedient to change the seed from an inferior to a superior climate. In Flanders, where great quantities of flax are grown, the seed must be brought from the Baltic; otherwise the crop will be deficient. In the case of potatoes, also, seed is imported from an inferior climate, as the most likely means of preventing the disease called the *curl*. It has fortunately, however, been discovered, that by taking up potatoes for seed, early, or sowing them so late that they cannot reach maturity, the same object may be obtained.

Besides changing seed, crossing different varieties has been found of use. Mr. Knight, has not only raised new varieties of apples, and of the garden pea, but has likewise tried experiments with crossing wheat, which he has effected by sowing the different kinds together. This was attended with a most extraordinary result; for when, in the year 1796, almost the whole crops of corn in the island were blighted, the varieties obtained by crossing, alone escaped, though sown in different soils, and in very different situations‡.

Sect. VIII.—*Quantity of Seed.*

It is hardly to be credited, how little this branch of the inquiry is attended to, or understood, in several districts. In

* Gentleman Farmer, p. 330.—To ascertain these points, an intelligent farmer in the Lothians, sowed English seed wheat, from London, with some of his own, and it was always earlier by several days. He has likewise tried sowing seed wheat, equal in quality to his own, from a situation where the climate produces crops ten days later than the farm he occupies, and it was nearly a week later than his own seed sown at the same time.—*Husbandry of Scotland*, vol. i. p. 355.

† Gentleman Farmer, p. 327 to 336.

‡ Sir Humphry Davy's Elements, edit. 1813, p. 225; and the Philosophical Transactions for the year 1799.

some, the quantity of seed sown is enormous, as a quarter of oats, or eight bushels per acre*. In others, they sow the some quantity of wheat in all seasons of the year, without paying much regard to the time of sowing; though two, or three bushels of seed sown in August or September, is equal to four bushels and upwards, sown in the latter end of November, or in spring. Thick sowing must occasion a great deficiency in early sown wheats, in weak and shallow soils; for though they may be in heart sufficient to push a number of plants through the winter and spring, yet the vigour of the soil is spent in the earlier stages of vegetation: the straw is slender and scanty, and the ears abridged of half their load. Whereas, had there been only a due proportion of plants, the exhaustion, during winter and spring, would have been less severe, and the strength of the soil would have been reserved, for the more material purpose of perfecting the plants in harvest†.

In treating of this subject, it may be proper to lay down, 1. The rules to be recommended respecting the quantity of seed in general;—and, 2. The fittest proportions for the different crops.

General Rules.

1. The first point to be considered, is, *The Climate.*—In a district where a crop is likely to experience favourable seasons, a less quantity of seed will be required, than where it is liable to a succession of variable weather, and occasionally, to great storms of rain or snow, or to severe frosts. Indeed, where the climate is uncertain, it is necessary to employ a sufficiency of seed, to provide against accidents.

2. The nature of *The Soil*, and its state of fertility, are the next points to be discussed.—On light thin soils, for the reasons already assigned, the quantity of seed ought to be moderate; whereas, in strong, stiff, wet, retentive soils, on the other hand, as the plants seldom branch off much from the roots, a large proportion of seed will be necessary, in order to secure such abundant crops, as lands of this description are capable of supporting. But where such lands are well prepared, rendered friable by a summer fallow, and in high condition, a small quantity of seed is sufficient; for though the crop may appear thin during the winter, the seedling plants have time and vigour enough to fill up the

* Marshall's Yorkshire, vol. ii. p. 20.
† Marshall's Norfolk, vol. i. p. 224.

field, by means of suckers, or lateral plants, which branch out from the principal root, and produce a full crop in autumn*.

3. The next point for consideration, is, *The Season when the Seed is sown*, for it is evident, that seed sown early, takes deeper root, and has more time to branch out additional shoots, than that which is late sown. Hence a less quantity is sufficient. Indeed, with late sowing, the progress of the crop may be retarded by dry and hot weather, unless a large quantity of seed be employed, so as to afford protection to the soil, from the mischiefs of evaporation, by the plants growing closely together. It seems to be a judicious rule, on soils of a medium quality, where wheat is sown broad-cast, to use about two bushels and a half, towards the latter end of September, and to add a gallon of seed for every fortnight afterwards†.

4. *The state of the Weather, when the Seed is put into the ground*, must likewise be considered; for where the season is very dry, and where there is a small proportion of moisture in the soil, more of the seed may fail to vegetate, than where the contrary is the case. Hence a larger quantity is required; and hence the propriety, not only of a larger quantity of seed, but the practice of steeping and putting in the seed in such dry seasons, immediately after the plough‡.

5. *The manner in which the Operation of Sowing* is carried on, it is obvious, must make some difference in the quantity sown. Where the broad-cast system is adopted, a larger quantity of seed is required, than where the grains are deposited, with equality and exactness, only on certain portions of the land, as is the case in the drill and dibbling methods. Where the grain is scattered over the whole surface of the soil, in some measure, at random, it is exposed to the depredation of birds, and some of the seeds may not be placed in a situation favourable to vegetation. At the same time, the saving of seed, under the drill system, cannot be carried to any great extent, without the risk of disappointment§, though it may in dibbling.

6. In regulating the quantity of seed, it is necessary also

* General Report of Scotland, vol. i. p. 456.

† Remark by John Middleton, Esq.

‡ Dickson's Practical Agriculture, vol. viii. p. 451.

§ Impressed with this idea, Mr. Coke of Norfolk, sows, under the drill system, four bushels of wheat, three of barley, and six of oats, per statute acre.

to have in view, *Whether Clover is to be sown with the Grain;* for in that case, it is evident, that a smaller quantity of the grain seed ought to be used, otherwise the clover may be materially injured, by a superabundant crop of grain.

7. *The Quality of the Seed,* is another point to be attended to, for it cannot be doubted, that a less quantity will be sufficient, where it is known, to be good and perfect of its sort, than when from age, an unfavourable harvest, or otherwise, it is known to be the reverse. In the former case, every seed will vegetate, whereas, in the latter, many must prove faulty.

8. The last point relates *to the size of the Seed;* for the smaller the size, the greater number of plants will be produced from a certain weight of corn; and when the grain is round and plump, its being moderate sized, does not make it less fit for the purposes of vegetation*.

Proportions of Seed for the different Crops.

It is to be regretted, that the proportions of seed best calculated to afford the fullest and most abundant produce, in different crops, and under various circumstances, has not yet been decided by the aid of experimental investigation. The following hints, it is hoped, will throw some light on this branch of the subject.

Wheat.—When land is in high condition, and adapted for wheat, more especially after a summer-fallow, about two bushels per acre has been generally found sufficient, in the best cultivated districts of Scotland. Bean stubbles require more seed than summer-fallows, because the seed, from the roughness of the surface, cannot be so equally distributed; and clover leys, ought to have more seed than even bean stubbles. Turnip land, sown with wheat in spring, must have a still more ample allowance, as the shorter period of growth, does not leave a sufficient interval for tillering, and many of the suckers that are produced, never come to maturity. In these cases, from three bushels up to rather less than four, may be required†. In England, it is calculated, that about two bushels and a half is the medium quantity of seed wheat throughout the kingdom‡, though it is often more.

* Remark by Edward Burroughs, Esq.

† General Report of Scotland, vol. i. p. 456. Brown on Rural Affairs, vol. ii. p. 16.

‡ Marshall's Gloucestershire, vol i. p. 118.

Barley.—The quantity of seed for a crop of barley, varies from two bushels and a half, to four bushels per acre; but it is always safer to give too much, than too little seed. It is a rule, indeed, with all spring-sown grain, to give a sufficient quantity of seed, to ensure a full crop from the first growth, and not to depend upon tillering, or planting out. With a full quantity of seed, the crop grows, and ripens equally, and, unless in very unfavourable seasons, the grain is uniformly good. Barley, being generally sown in the dry seasons of the year, the plants are often stunted in their growth, and unable to send out off-sets to stock the soil. The plant may afterwards stool or tiller at a later period, but these young shoots, cannot be expected to arrive at maturity, or if their ripening is waited for, there is a great risk of losing the first, or earlier growth of the crop*.

Oats.—The quantity of seed for a crop of oats, is generally from four to five Winchester bushels per statute acre; though in Devonshire they go as far as six bushels, and in Yorkshire to eight†. The amount must depend upon the richness of the soil, and the variety that is cultivated. The potatoe-oats, not having any tail-oat, like the ordinary sorts, and tillering well, require much less seed, in point of measure, than the other sorts; and may be safely trusted, when the land is equally well cultivated, with as small a quantity of seed as barley, namely, from two and a half to four bushels‡. It is, however, to be observed, that as oats, in general, are cultivated on weak and inferior soils, and in cold climates, the quantity of seed should be increased in proportion as these circumstances operate.

Beans.—In the culture of beans, different quantities of seed are used in England and Scotland. In the former, three bushels per acre is considered to be a sufficient quantity, if drilled, and four, when broad-cast; but in Scotland, four bushels are required when the beans are sown in drills,

* General Report of Scotland, vol. i. p. 489.—Brown on Rural Affairs, vol. ii. p. 45.—The ideas and experience of the farmers in Ireland, are totally different. In that country, barley, in well cultivated and good soils, tillers as much as wheat, and the head produced from these collateral shoots, are as productive, as from the main stem, or parent plant. Some of the best farmers in Ireland, sow their barley *thin*, on well prepared land, and find it injudicious to sow it on lands on which the plant would not tiller.—*Remark by Edward Burroughs, Esq.*

† Marshall's West of England, vol. i. p. 194. Ditto, Yorkshire, vol. ii. p. 20.

‡ General Report of Scotland, vol. i. p. 501. Brown on Rural Affairs, vol. i. p. 49.

and five bushels if sown broad-cast. Perhaps this may be partly owing to the difference of climate, beans being sown early, and exposed to much severity of weather. Besides, it is maintained in Scotland, that unless the rows of beans close effectually over the land, weeds will unavoidably grow, and flourish, after the cleansing process is finished. The land will thence become foul, so as to defeat the very object of the drill husbandry, the crop will be proportionably injured, by being robbed of its nourishment, and the land will be left in a wretched condition, compared to that in which it ought to have been placed*.

Pease.—When drilled, four bushels of seed are considered to be sufficient, but when sown broad-cast, from four to five bushels are supposed to be necessary. Much, however, must depend upon the size of the pea, the luxuriance of its growth, and the peculiar qualities of the variety sown, for three bushels of the grey pea, as seed, is found equal to four of white†.

Clover and Rye-grass.—It is not advisable to sow at the same time, a mixture of light and heavy seeds, as clover, and rye-grass. It is impossible that it can be done correctly; and it is much more prudent, to go once over the ground, with each sort of seed. The usual quantity per statute acre, is from ten to twelve pounds of red clover seed, and about a half, or two-thirds of a bushel of clean and well-dressed rye-grass seed. If the rye-grass *is cut young*, it is not injurious to the soil.

On the whole, seed ought not to be distributed with too rigid economy, as a full crop of any grain whatever, is cheaply purchased, by giving a sufficiency of seed; while a scanty crop, besides being in itself unprofitable, is sure to poison the land, by facilitating the growth of weeds‡. There is a happy medium, however, in this, as well as every thing else. For a crop may not succeed, when the plants are too numerous in the ground, any more than when they are too few. Their over-luxuriance may likewise be prejudicial, by retarding the ripening, and hazarding the safety of the crop§.

* General Report of Scotland, vol. ii. p. 519. Brown on Rural Affairs, vol. ii. p. 61.

† Marshall's Norfolk, vol. i. p. 251.

‡ General Report of Scotland, vol. i. p. 530.

§ Coventry's Discourses, p. 84.

Sect. IX.—*Preparing the Seed for Sowing.*

With a view of bettering the future crop, husbandmen have attempted, in various ways, by preparing the seed for semination, to accomplish four objects:—1. The discovery of weak or faulty seed;—2. The preservation of the seed from the attacks of vermin of various sorts;—3. The promoting of the semination and growth of the future plants;—and, 4. The prevention of certain disorders, to which they might otherwise be liable*.—The fourth point shall be the subject of future discussion;—the other three shall be briefly considered in this place.

1. In order to detect and separate imperfect and disordered seeds, from those which are sound, and fit for sowing, it is only necessary, to pour the grain, gently, either into common water, or into a solution of salt and water.—In this way, the imperfect and disordered seeds, from being lighter, are soon discovered; for they swim on the surface, and can easily be skimmed off, either when at first poured in, or every time the mass is stirred.—Common water is in general considered to be sufficient; but the addition of salt is of use, by increasing the specific gravity of the liquor, and consequently bringing up grain, in a lesser degree deficient in weight. The solution should be made so strong, that an egg will swim in it.

2. Steeping seed for its preservation against vermin, (as insects, birds, field-mice, &c.), is principally effected, by employing some article, as train oil†, stale urine, &c., that has an offensive smell, and deters them from approaching it.—For that purpose, the Romans used the lees of oil, decoctions of cypress-leaves, juice of house-leeks, &c. and they placed great dependence on the virtues of these applications. In modern times, saline and caustic particles, are applied to the seed of barley and oats, as well as of wheat,

* Coventry's Discourses, p. 80.

† For three seasons, the plan of steeping turnip-seed in train oil, prevented the attack of the fly at Lord Orford's, in Norfolk.—The evening before the seed was to be used, as much as would be required the next day, was first steept in train oil, and then kept in salt pickle during the night.—Seven gallons of oil, is sufficient to prepare seed for two hundred acres of turnips. There was a partial failure of this process, to the amount of thirty acres, which was attributed to an excessive rain having fallen, by which the noxious quality of the oil was destroyed.—*Annals of Agriculture*, vol. xiv. p. 168.

to preserve it from the attacks of vermim, or to destroy such as may venture to eat it.

3. Attempts have also been made, to promote the germination, and the growth of plants, by steeping them in water, and other substances, with a view of securing in spring, a few days' start in vegetation.

Some farmers have steeped barley in pure water, from 16 to 24 hours, if it is to be sown in light soils, where there is not a likelihood of sufficient moisture being in the land, to promote germination; and some accounts have been published, of considerable success attending that practice.—It is very hazardous, however, oversteeping the seed, lest it should destroy the embryo plant; and it is recommended, to roll the soil afterwards, that the moisture in it may be retained.—The application of dunghill water, however, to seed-corn, seems to be still more useful*, more especially if the urine of cows is made use of, which contains a great deal of ammonia, and in which no seed can be safely kept above an hour.

Gardeners frequently steep beans to accelerate their growth, and some farmers have found it of advantage, in late situations, to adopt this practice, to a considerable extent.

They have a practice in Switzerland of steeping the seed of clover, in common oil, for an hour or two, to prevent the attacks of insects. It should then be mixed with powdered gypsum, to promote a rapid vegetation. The same plan might have similar effects on turnip-seed, and prevent those risks to which the crop is liable in its early stages. Oil is peculiarly destructive to insects, *when applied outwardly*, as it stops up the pores of the skin. When taken inwardly, it is not so injurious.

* In the spring of 1783, a farmer in Cornwall, (Mr. James Chapple, in Bodmin), soaked his seed barley in dunghill-water, in which it lay for 24 hours. All the light corn which floated on the surface, was skimmed off.—On taking it out of the water, a sufficient quantity of sifted wood-ashes, to make it spread regularly, was mixed with the seed; and three fields were sown with it.—The produce was 60 bushels per acre, of good clean barley; while several fields belonging to the farmer himself, and to his neighbours, where no preparation had been used, were very poor, not producing more than 20 bushels per acre. (*Papers of the Bath Society*), vol. iii. p.305.—Dunghill water, however, must be used with great caution, as a steep. If diluted, it can do no great harm, but if kept for some time, in a concentrated state, it becomes highly putrescent, and may prove detrimental, and indeed may destroy the vegetative powers of the plant.

Sect. X.—*Season for Sowing.*

The period of sowing the different grains, varies so much, according to situation,—soil,—climate,—species,—and a number of other circumstances, that it is impossible to lay down any general rule, but this, "That early sowing is, on the whole, to be recommended*.—It has been found, by a number of accurate experiments, registered in Dr. Hunter's Georgical Essays, that, in England, from the middle of September, to the middle of October, is the best time to sow wheat.—It is true, that all farmers cannot complete their seeding within this time, but it is important, that they should attend to it as far as it is practicable.

On several accounts it is desirable, to sow before winter, or early in that season, to as great an extent as circumstances will admit of.—1. Because when a good deal of work is over in winter, there is less to do in the spring;—2. As when the seed is sown in winter, a less quantity will suffice;—3. Because the crop will be ripened earlier, which in times of scarcity, may prevent the calamities of famine;—4. As when a crop is sooner ripe, it is less liable to disease in its progress; or to injury in time of harvest;—and, 5. As it may be possible, to obtain a second crop in the course, even, of that year.—This is frequently the case in Flanders, and even in England, where "*stubble turnips*," as they are called, are often raised.

On all these grounds, it is well entitled to the consideration of the farmers of Great Britain and Ireland, whether two sorts of grain, barley, and oats, commonly sown in spring, may not, to *a certain extent*, be sown previous to winter.

In regard to barley, the two-rowed grain will not answer; but there can be little doubt that the four-rowed, or the six-rowed varieties, would succeed. The Flemish derive great advantage from the cultivation of *sucrion*, or winter barley, which they greatly prefer to the spring. It ripens earlier;—is more productive†;—sells at a higher price;—

* It is an old proverb, "That an early sowing sometimes deceives, but a late sowing never, for *the crop from it is always bad.*"—*Dickson's Husbandry of the Ancients*, vol. ii. p. 18.

† Its produce on the *Polders*, or carse lands, is ten quarters per English acre, or fifteen bolls and a half, per Scotch acre. Carse land is peculiarly calculated for this species of grain. *Radcliff's Flanders*, p. 15.—In Ireland, it is known under the name of *bere* or *bigg*, and is frequently sown in autumn, with much success. It is considered a valuable crop on lands that have

and yields a greater quantity of malt liquor, or spirits. A valuable crop of turnips may likewise be raised after it*.

As to oats, autumnal sowing is strongly recommended by its success in Ireland. The plan is not calculated, however, for cold or poor soils; but in rich and fertile land, there can hardly be a doubt of its success. The oats should be sown in September, or the beginning of October. As the crop will tiller in the spring, about half the usual quantity of seed will be sufficient. This practice answers best in a dry soil, but where moisture is likely to be injurious to the crop, the furrows should be gone over by a plough, without a mould plate, and the mould or loosened earth, should be thrown, by spades or shovels, upon the land sown with the oats. If the crop is too luxuriant in spring, it may either be cut with the scythe, or fed off with sheep, in the months of February or March. This is of use to the crop, though it may retard the ripening. But after all, it will be a fortnight or three weeks earlier for the sickle, than the spring sown, and the produce will be more abundant. If possible, seed should be procured from a crop that had been sown in winter, as such, oats will naturally produce plants of a hardier nature, than could be obtained from spring-sown corn. The Tartarian oat, as being of a sort peculiarly hardy, has been strongly recommended for trying the experiment†.

Sect. XI.—*Of Sowing, (Drilling included), and on the practice of Transplanting Grain.*

The most advantageous mode of depositing the seed in the ground, and also of covering it, is one of the most important subjects of agricultural inquiry. It has of late attracted particular attention, and has been discussed, not only in various publications, but at numerous meetings of practical farmers. It may be treated of under four heads: 1. Broadcast, or surface-sowing;—2. Ploughing in;—3. Drilling, and other modes of cultivating in rows;—and 4. Dibbling.

been pared and burnt, and on lands of a friable, and a fertile quality.—*Remark by Edward Burroughs, Esq.*

* Winter barley has been sown by Mr. Ellman of Glynde, in Sussex, principally as spring feed for his sheep, but on the whole, he prefers rye, being a fortnight earlier.

† Communication from Thomas Radcliff, Esq. of Globe-Hill, near Enniscorthy, in Ireland.

To these we shall subjoin, some observations on "The transplantation of crops."

1. *Broad-cast, or Sowing on the Surface, and Harrowing in the Seed.*

This mode, which formerly was most probably universal, is still very generally adopted in many districts of these kingdoms, and is the usual practice in the greater part of the Continent.—The process is a difficult one to execute well; and it is impossible, from any description, to form an idea, of the measured step, the regular handfuls, and the artificial cast which the sower acquires, and which can be learned only, by inspection, imitation, and practice. A skilful and experienced sower, regulates the prescribed quantity of seed to the acre, with wonderful precision, and distributes the seed over the ground, with the most exact equality. It is often, however, very imperfectly executed; and even where it is done well, it must depend upon the subsequent operation of harrowing, whether the seed is deposited at the proper depth, so as to germinate with advantage.

It is objected to this process, by those who have adopted a more correct one, that it is slovenly;—that it is difficult to conduct it properly in windy weather;—that the seed is placed at unequal depths;—that a very large proportion of it is either left but thinly covered, or is sunk too deep in the soil;—that a heavy loss must be sustained, from the quantity that is exposed to the attacks of birds, and to the injury that may be sustained from great droughts, or severe frosts;—and that unless skilfully done, a part of the ground may remain unoccupied.

Notwithstanding these objections, the broad-cast system has continued to prevail in various districts, not only on account of its simplicity, and its requiring less expensive machinery, but, where the climate is unfavourable, or the seasons unusually backward, from the expedition with which it is executed, and the greater certainty of effecting the object in any season*. Indeed where the climate is un-

* Several farmers, who are friends to the drill, admit, that in unfavourable seasons, they are sometimes under the necessity of resorting to surface-sowing. *Mr. Denny, of Egmere in Norfolk*, states, "That at times, every practical farmer will admit, that a good seedsman may be employed to advantage, more especially in a backward season; if *flag-land*, (or clover layer), the common harrow to follow; if *broken* (or cultivated) soil, ploughing under. In a wet time, he prefers sowing barley broad-cast, and to harrow in, or plough under, as the state of the soil best admits of." See also Mr. Grove's Letter, dated 18th October, 1819, (Farmer's Journal).

favourable, any additional time and labour required, more especially during the seed process, are very important considerations to farmers. Their establishment of men and horses, (the heaviest of the charges on agriculture), is economically proportioned to the work of the whole circle of the year; and, independently of all other considerations, the sowing by the drill, requires more time than surface-sowing.

Instead of sowing broad-cast by the hand, machines for that purpose have been invented. By them, the corn is delivered with great regularity, from a horizontal trough, ten feet in length, by brushes, upon a turning axle, worked by the rotation of the wheel of the machine. The most improved kind has two wheels, and is drawn by a mule, or light horse, in shafts. A great saving of seed, and equable sowing, result from the use of this implement*. Such machines are likely to be particularly useful for clover, and other small seeds, which are distributed, by the hand, with more difficulty.

2. *Ploughing in the Seed.*

In the greater part of England, where drilling does not prevail, the seed is not harrowed, but *ploughed in, or covered by a furrow.* This is often done on light soils, by a light one-horse plough, immediately after the seed is scattered over the surface. But in many of the heavy soils of England, the seedsman follows the plough, scattering the seed by hand, *in the trenches of each furrow*, as they are successively formed, (called *straining in*, or *spraining*), and on the return of the plough, the seed is covered with earth†. As a preparation for this plan, the land is commonly fallowed, and cleared of weeds; it receives, where the process is properly conducted‡, five summer ploughings, the three first to the depth of seven inches, and the two last shallower, sufficient to

* Communication from the Rev. Thomas Radcliff.—This machine has lately come into considerable use in Ireland.

† This seems to be a most tedious process. Why should not the plough be followed by a small drill barrow, or such a barrow attached to the plough itself, which would at once introduce the row culture, into all the districts where the seed is covered by a furrow?

‡ It is much to be regretted, that fallowing is far from being, in general, *properly conducted*, in the open fields of England. Two ploughings, or at the utmost three, besides the seeding earth, is all that is given. It is not to be wondered at, that deficient crops should be produced by such deficient tillage. The land, though fallowed, is generally foul, because the land is not brought into a pulverized state sufficiently early to promote the germination of annual weeds, and to facilitate their destruction.

bring into a completely pulverized state, a quantity of mould for covering the seed, as soon as it is deposited. The bottom contains from four to five inches of, comparatively, firmer texture; but yet considerably tempered, on which the seed may rest. It is thus inserted at a proper depth, and deposited on a bed, the most congenial that can be devised, to promote germination, and the most favourable to its first efforts of growth. The substratum gives an admirable anchorage for the roots in the soil, and the fine earth by which it is covered, gives the least possible obstruction to its upward shoots. It is likewise protected from being root-shaken by frost, and from all those depredations, which are made upon seed sown on the surface, and afterwards merely harrowed.—By this method of preparation, therefore, many advantages are obtained, and a crop so conducted, may reasonably be expected, to be both luxuriant, and abundant in produce*.

Some eminent agriculturists, are so partial to the system of ploughing in, that they think it ought to be generally practised, in preference to every other mode of sowing grain; and that owing to its not being adopted, thousands, and tens of thousands of bushels of grain, are annually lost to the country. But it is evident, that on very strong soils, there is some risk of caking, more especially when the crop is sown in autumn, and exposed to the winter rains;—that if unskilfully executed, there is some hazard of throwing too much earth on the seed, so as to prevent vegetation;—and that it requires nearly as much time and labour as drilling, though without its expensive machinery.

3. *Of the Row Culture by Drilling, and other Modes of depositing the Seed in Lines.*

The question next to be considered is, whether *broad-cast sowing*, by which all the surface, is more or less regularly occupied with plants; or *sowing in rows*, with intervals, larger or smaller between them, for the admission of atmospheric influence, and for hoeing, to promote the destruction of weeds, be the preferable practice.

The system of drilling seed in regular rows, by machines invented for that object, is no new discovery. It has been

* Extracted from the Communication of Thomas Greg, Esq. of Coles, in Hertfordshire, to the Author, dated 7th January, 1819. The above is a description of the *ploughing-in* system, when executed in the best manner; but unfortunately, that is far from being generally the case.

practised from time immemorial in the East Indies*, and likewise been long known in Spain†. The introduction of that mode of sowing in this country, is justly attributed to the celebrated Tull, who founded it on the erroneous doctrine, that tillage, *even without manure*, would produce an endless succession of abundant crops.—That theory is fortunately abandoned, and the practice of drilling, being now established on rational principles, it is progressively increasing, much to the advantage of the farmer.

In discussing the subject of drilling, it is necessary to make a distinction between *leguminous*, or green, and *culmiferous*, or grain crops.

Drilling Leguminous, or Green Crops.

There is no question, but that the culture in rows, is best calculated for them, because, 1. It carries off the extra moisture in wet soils;—2. It exposes more surface to atmospheric influence, by which the soil is ameliorated;—and 3. It gives an additional opportunity for the vegetation, and the destruction of weeds.

Beans should be drilled, not only on loamy soils, but even on strong, and rich clays.—When drilled, from the manner in which the plants grow, the pods are placed on the stem, from the root upwards, and of course they must derive essential benefit, when filling, by the admission of air through the open space left between the drills. The soil is likewise meliorated by the hoeing, and weeds are destroyed‡.

Drilling for turnips is likewise greatly to be preferred. The superior facility afforded by the drill culture, of simplifying, and expediting hand-labour;—the advantages of applying recent and moist manure directly to the seed;—the more regular and correct adjustment of the number of plants to be left on a given space;—and the more equal ad-

* Engravings of these ancient machines, are inserted in the Communications to the Board of Agriculture, vol. i. p. 352.

† It appears from the London Philosophical Transactions, (Lowthorp's Abridgement, vol. ii. p. 738), that the Spanish "*Sembrador*," or drill machine, was invented by a Spaniard, prior to the year 1663; and the same arguments, as those now used in favour of drilling, were urged in its behalf.

‡ An experiment was tried between the drill and broad-cast husbandry, in the cultivation of beans, by M. Auguste Weiland of Ostend. He dedicated eighty French *ares* of land for that purpose, one half of which was sown broad-cast, and the other half drilled. Besides a considerable saving of seed, there was an increase of produce on the drilled part, in the proportion of eleven to nine. Next year the same field was sown with barley, when the produce, on the drilled part, was likewise increased as 34 to 27.—See *Radcliff's Report of the Agriculture of Flanders*, p. 10.

mission and circulation of air among the plants; entitle the drill system to a decided preference*.

Potatoes also, ought to be planted in rows by all farmers, whatever plan gardeners or cottagers, on small patches, may adopt. There ought to be a distance of from 24 to 30 inches between each row, so that the fibres which nourish the plants, may not be disturbed by the hoeing; for if they are injured, the stems will be puny, and the bulbs few and small†. Drilling is greatly preferable to dibbling potatoes, as appeared from an experiment, expressly made to ascertain the advantages of each mode of culture‡.

The drilling of carrots has not been found to answer in Suffolk; but it has succeeded in the experience of Mr. Butterworth, and others, in Scotland, and of M. Chateauvieux, in Switzerland, with very wide intervals. This useful plant, can thus be cultivated with profit, on soils where otherwise it would hardly be practicable;—the drills furnishing an artificial depth of soil, in which this root can be raised. Fourteen inches between the rows is recommended as the proper distance§.

In regard to pease, whether sown with a mixture of beans, or not, drilling is to be preferred to the broad-cast system, though the hoeing is attended with difficulty, owing to the plant falling so early down upon the surface. The rows ought to be from 20 to 27 inches asunder, and the intervals repeatedly hand-hoed.—Any weeds that may grow among the pease, may be pulled up by hand. It has been found that pease, properly drilled, and carefully hoed, were, at harvest, nearly as clean as the beds of a garden, and the produce, both of grain and of haulm, quite satisfactory; whereas the head-lands, which had been sown broad-cast, had a miserable crop of grain, thinly scattered among a multitude of annual weeds, and scarcely worth reaping‖.

As to tares, they are sometimes drilled, particularly when sown in spring¶; but broad-cast is the more general practice, when sown in autumn. When drilled, the rows should be fifteen inches apart; and in strong tenacious clays, this crop, when repeatedly hand-hoed, is said, in dry seasons, to be more profitable than beans**.

* Communication from Mr. John Shirreff.

† The drills of potatoes are in general much too close. In Ireland, 3½ feet is recommended.

‡ Phytologia, p. 441. § Amos on Drill Husbandry, p. 190.

‖ General Report of Scotland, vol. i. p. 529. ¶ Kent Report, p. 107.

** Communication from John Middleton, Esq.

Drilling Culmiferous or Corn Crops; with Observations on the Row Culture, for Crops of Grain.

The question, whether it is most expedient or profitable, to raise culmiferous crops, according to the broad-cast, or drilled system, has agitated the agricultural world for a number of years; and as it is a point, respecting which there still exists a great diversity of opinion, it may be proper here to detail, the arguments on both sides, that the reader may be enabled to form a decided opinion, which ought generally to be preferred; and in what particular cases, either the row, or the broad-cast system of culture, ought to be adopted.

The arguments against drilling, are, 1. That it is not likely to be profitable on a small scale, on account of the expence of the machinery for the different operations of sowing, hoeing, &c.;—2. That these operations, must often occasion delays, incompatible with the hurry of an extensive autumnal or spring sowing; at least in wet seasons, and on wet soils, however little it may be felt in dry seasons, and on dry soils;—3. That the drill machine does not answer where the soil is too full of small stones, to allow the coulters to sink to a proper depth, and, of course, that the seed is not sufficiently covered to produce an abundant crop*;—4. That it is not so well calculated for steep lands†;—and 5. That the grain is more liable to be shaken by winds, and the harvest to be later on drilled fields, than on those which are sown broad-cast, and consequently, that it is not so well calculated for a windy and a northern climate.

Some other objections were formerly urged against drilling, which the recent improvements in the system have effectually removed.—For instance, it was anciently the practice, *to earth up the plants*, the consequence of which was, that in rich soils, the vigour of the soil was exhausted on the stems or foliage, instead of the fruit, and though the straw was strong and abundant, the grain was often defective in quality, or greatly diminished in quantity; whereas, now, it is a maxim in the school of Holkham, "*That white straw crops will be injured, if earthed up upon any soil*‡."

* The use of "*The Lever Drill*," removes this objection.

† This objection is obviated, by an addition to the machinery. The seed-box is fastened on a pivot, or by a screw, and the position of the box is adjusted to the ascent or descent, without any difficulty.

‡ Communication from Mr. Blaikie, at Holkham. Yet, *in very poor soils*, it may be expedient to try the effect of earthing up, with wider intervals, so that the hoeing will not injure the surface roots. In rich soils, it would be decidedly injurious. It was only on that point, that the Author

It is likewise urged, that it might not be practicable in many districts, to find a sufficient number of labourers, to hoe the drills, were all the crops on a farm to be subjected to that process. But in the present state of the country, with an overflowing, and unemployed population, a new source of occupation to the peasantry, would be most desirable, provided their employers were remunerated for the expences they incurred*;—and where there is a scarcity of male labourers, women and boys, have, in many of the agricultural districts, as in Gloucestershire, been taught the art, and have been found most expert at hoeing.

It has farther been urged, against the use of the drill machine, that where seed has been steeped, and encrusted with lime, as a preventive of the smut, the lime destroys the brushes, and impedes the regular delivery of the seed.—But this objection is easily removed, by using *cups*, instead of brushes, or by steeping the seed in a solution of the sulphate of copper, in a manner to be afterwards described, (See Sect. 22). The seed, in that case, might be sown in a few hours after the solution has been applied, *without lime*, and with a certainty of preventing smut.

The introduction of the drill system, is, by numbers of the most distinguished agriculturists, considered to be, the most important of all modern improvements, and to be well entitled to universal adoption. It is principally recommended on the following grounds :—1. That the broad-cast system, is a less perfect, and a less economical mode of cultivation, than that of drilling, for the seed can neither be deposited in the soil, with the same exactness in regard to depth, regularity, or proportion†, nor be so placed, that the crop can afterwards be improved in its progress to maturity‡;—2. That in light soils, drilling has the important advantage, of giving the grain *a good hold* of the ground, and of giving all the seed the same depth of soil§, by which the frost is prevented from throwing out the plants in spring,

entertained any doubt as to the utility of drilling, which the new practice, of avoiding earthing up, has removed.

* Remark by Edward Burroughs, Esq.

† It is a great advantage to place the seed at a proper depth, so as to secure a sufficient degree of moisture to promote germination; and to make this deposition uniform, that the grain may spring and ripen more equally.

‡ Dickson's Husbandry, vol. i. p. 456.

§ This is an advantage peculiar to drilling, for when crops are *ploughed in*, some of the seed will go to the bottom of the furrow, some will be left half way, and some will even be left at the top. In fact, the depth of seed, when ploughed in, unless well executed, is often more irregular than when harrowed in.—*Remark by Mr. Wilkie of Wimpole.*

or the wind from loosening the roots, after the stem gets high, or when the ear is filling;—3. That by the improved practices in drilling, the use of manures is both encouraged and economized, so as to diminish the quantity necessary, and to increase its powers, by bringing it into immediate contact with the plant*; and that a heavy crop of drilled corn, where the weeds are thoroughly destroyed, will be found much less injurious to the fertility of the soil, though raised with less manure, than the same crop grown broad-cast, with a greater quantity of manure, but incumbered with weeds;—4. That it gives an opportunity for cleansing the ground, even when the crop is growing;—of completely extirpating annual weeds;—of checking the growth of root-weeds;—and of preventing weeds in general, from being injurious to the crop;—5. That if the land is not hoed, but hand-weeded, less damage will be done to the crop, by the weeder's feet passing *between* the rows of plants, than by *treading upon them*, as must inevitably be the case, when working promiscuously over the ground;—6. That the progress of the grain, after the scarifier has worked upon the soil, is attended with the most beneficial effects †;—7. That drilling is peculiarly calculated *for inferior soils*, and brings their produce more nearly on a footing with that of fertile land, than could otherwise be obtained‡;—8. That the pulverization of the soil between the rows of autumn or winter-sown wheat, is of the greatest benefit to the clover seeds sown in spring, and that the admission of air between the rows, is of use to the corn crop§, as well as to the grass-

* On a field sown in drills 12 inches apart, which received one hoeing in spring, a more productive crop, and by far more valuable grain was raised, than on a broad-cast crop, which had received three times the quantity of dung. The manure for the drilled crop of wheat, was applied in drills made by the plough, the seed sown, and then harrowed down.—*Remark by Edward Burroughs, Esq.*

† Communication from J. C. Curwen, Esq. M. P.

‡ Mr. Blaikie, at Holkham, states, that it is no uncommon circumstance, to have from inferior land in Norfolk, rented only at from 15 to 30 shillings per acre, as much produce as from land, that, in other districts, pays from 5*l.* to 6*l.* per acre. From land of an inferior quality, paying only 20*s.* for rent, and 5*s.* for tithe, 41 bushels of wheat per acre have been obtained, under the drill system.

§ It is absurd to suppose, that the access of *air*, so essential to the growth and health of plants, should not be of service to the roots of plants, if means could be contrived, (as is the case under the drill system), by which its access can be obtained.

Where soils are *very poor*, the plan adopted in the cultivation of turnips, ought to be extended to grain, that of placing the manure, in the centre of a drill, and sowing the grain above it.

seeds sown with it;—9. That drilled crops of white corn, from the greater strength of their straw, are less apt to lodge, or to be beaten down in wet seasons*; and are much less subject to other casualties, in particular, to the diseases to which wheat is unfortunately liable;—10. That the expence of cutting down a drilled crop in harvest, is uniformly less, than of one which is sown broad-cast, since three reapers will do as much work in the former case, as four in the latter†;—11. That drilled crops are more equal in growth, and in general better in quality than the broad-cast; and 12. That drilling may be of use in regard to the grub, and other vermin. The hoeing in spring may assist in destroying them, or, at least, by the treading of the hoers, and the stirring of the soil by the hoes, a check may be given to their depredations. The treading also, may be of use in preventing the mildew‡.

In regard to any saving of seed, which by some is considered an advantage, Mr. Coke of Holkham is decidedly of opinion, that such an idea is founded on erroneous principles, and that any economy of that sort, ought not to be attempted §.

Innumerable instances might be brought forward, of heavy crops having been produced under the drill system, by those who have bestowed much care in trying the experiment;

* This has been doubted, but the drillists are in this point supported by respectable authority: the Rev. Adam Dickson, in his Treatise on Agriculture, vol. ii. p. 61 and 62, remarks, "That weeds keep the air from the roots of corn, and thereby expose it to be lodged." He observes, in another place, "That when corn is sown in rows, with intervals, the admission of air, strengthens the stalks, which prevents the corn from lodging," vol. i. p. 526. Besides, it is well known, that when corn is lodged, it suffers less, if it has been drilled, than the broad-cast, there being, between the rows, an admission of air, which tends to dry the stems, and to render it sooner fit for being harvested.

† Husbandry of Scotland, vol. i. p. 347.

‡ Drilling was also considered to be greatly superior to broad-cast, when the seed was sown in windy weather; but machines have been invented, by which grain may be scattered over the surface with regularity and safety, whatever the state of the weather may be.

§ Many practical agriculturists, however, warmly oppose the universal application of this doctrine, more especially in regard to rich and mellow soils.—It is justified, however, by the following remark by the Rev. Adam Dickson, a clergyman in East-Lothian, who published in 1788, an Account of the Husbandry of the Ancients, in which, (vol. i. p. 526), there is the following paragraph:—"Plants of corn, to a certain number, placed near to each other, instead of being weakened, are thereby strengthened. It is an advantage, therefore, to sow corn, either in broad rows, or where the rows are narrow, *very thick*, provided there are sufficient intervals to admit the *air*, and to give the plants room to extend their roots."—One would think, that this intelligent author, had foreseen the system of the Holkham school, as to thick sowing.

and it has often answered, even on a great scale, when properly executed*.—But its success must depend upon the intelligence, attention, perseverance, and capital of the farmer.

As it has been carried to the highest perfection, and cultivated to the greatest extent, on the farm, and on the estates, of that distinguished agriculturist, Mr. Coke of Holkham, it may be proper to give a short account of his practice. He uses the Rev. Mr. Cooke's drill, which sows six rows at a time, and an acre in an hour, drawn by a single horse. His wheat he sows at nine inches asunder, his barley at six inches three quarters. The quantity of seed he sows per acre, is three bushels of barley, and six of oats†.—In regard to wheat, the average quantity he prefers, is four bushels per acre.—By depositing such a quantity of seed, there is no occasion to earth up the plants, for the sake of promoting tillering‡. On rich soils, it is the practice, to draw the drills from north to south, because the rays of the sun, when in his greatest altitude, striking directly between the rows of corn, have a powerful effect in strengthening the straw, and by absorbing the damp from the earth, become a powerful auxiliary in preventing mildew.—On poor soils, on the other hand, the lines should be drawn from east to west, if the nature of the ground will admit of that plan being followed. Cooke's fixed drill-harrow is used once in spring, the hand-hoe is used twice, the land is cleared of weeds, but the soil is not

* The following is an account of a most important experiment tried by John Brodie, Esq. of Scoughall, in East Lothian:—Ann. $18\frac{15}{16}$, he drilled, in all, about 150 Scotch, or 188 English acres, with wheat.—The soil principally consisted of light loam, much subject to annual weeds.—On comparing the produce on that soil, the broad-cast produced only 35 Winchester bushels per acre, the drilled 42;—but as the broad-cast weighed 66lbs. per firlot; the drilled only 65; the difference in favour of the drill, is as 41 to 34.—By hoeing the drilled crop, great vigour was given to the young crops of wheat. All the weeds of the mustard tribe, were as carefully taken out of the broad-cast crop, as out of the drilled, but the smaller weeds could not be equally well extirpated in the broad-cast.—The grass-seeds sown with the drilled crops answered better than with the broad-cast, owing to the ground being effectually cleansed of weeds by the hoeing; whereas, under the broad-cast system, grass-seeds, even after they have come up, are frequently injured by small weeds, which could not be got at when the ground was covered with a broad-cast crop.—Mr. Brodie, who is perhaps the greatest arable farmer in Europe, paying of rent, about 7000*l.* per annum, states, in a recent communication to the Author, That he continues to drill every year, and that he is convinced, his crops are benefited by the practice.

† Communication from Mr. Blaikie, at Holkham.

‡ Dr. Rigby's Report, p. 18. This is the greatest improvement that has taken place in the drilling system; for it was *the earthing up, in rich soils*, which rendered the crops too luxuriant, and consequently unproductive. The great quantity of seed sown at Holkham, has the effect of preventing tillering; the ears thus become ripe, at nearly the same period of time, and thus a sample *equally ripe*, is produced, in which respect, drilled corn, is sometimes deficient.

earthed up, or accumulated against the corn.—The hoeings cost about twenty pence each, per acre.—The largeness of the crops, particularly of barley*, and oats, raised even on poor land, under this system, is hardly to be credited†; and they are sometimes also of a superior quality‡.

A great improvement has recently been made in drilling, by the introduction of "The Inverted Hoes," invented by Mr. Blaikie§. They consist of a pair of blades for each interval, going one before the other, and each having *the heel* turned to the row. This disposition of the blades prevents, 1. *Cutting the plants, or their roots;*—2. *Moulding up;*—and, 3. *Clogging*. They may be used, though the rows of corn are only nine inches distant from each other; and it is found, that the occasional trampling of the horse, on the young plants, is not attended with injurious consequences‖.

It was formerly believed, that drilling was only applicable to light soils; but in Suffolk, strong or heavy land is now cultivated for spring crops, in drills, in a most perfect manner. The ridges are all carefully ploughed in autumn, or early in winter, to *the exact breadth* which suits either one movement of the drill machine, or two. In the spring, the land is only scarified or harrowed, as it has been rendered thoroughly friable by the winter's frost, and the corn is drilled, without a horse's foot treading any where, except in the furrows between the ridges¶. Unless this practice is adopted, it would be difficult, in very wet seasons, to carry on the operations of the drill system, on heavy soils, with the regularity and exactness that is necessary**.

* The crop of barley is sometimes so strong, that if a hat is thrown into a field, it rests on the surface. This is called *hat-barley.—Young's Norfolk*, p. 251.

† It is observed, that on light soils, short ears of wheat are the most productive, and that the sample is most uniform and weighty. In barley, long ears are preferred.

‡ Young's Norfolk, p. 246.

§ "*The inverted hoe*," is so called, from the shares being turned inwards, and placed something in the form of a cock's spur. This hoe, it is said, far surpasses any other now in use, being worked with perfect safety between rows of plants, while in their infancy, even as soon as they appear above ground; and it effectually cuts up all weeds between the rows. It is well calculated for a potatoe crop, sown in ridges, being less likely to injure the fibres of the plant. The inverted hoes are of two descriptions, one is adapted for clearing between the rows of plants, either at wide or narrow intervals, *sown upon the flat;* the other at wide or narrow intervals, *upon the ridge.*

‖ This would be a sufficient answer to the objection on the score of a scarcity of labourers, to carry on the drill system.

¶ Communication from the late Arthur Young, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 66.

** Dickson's Husbandry, vol. i. p. 401.

In other parts of England, as in Kent and Hertfordshire, the drilling of strong lands is practised, for winter as well as spring crops; and Mr. Childe, in Shropshire, drills all his crops, on the most adhesive clay, and in a hilly country, with the greatest success.

The propriety of drilling in Scotland, owing to the peculiar circumstances of its soil and climate, requiring to enter more into detail, it shall be discussed in the Appendix.

Besides drilling, &c. as above described, there are other modes by which grain can be cultivated *in rows*. Sometimes, by means of a drill-roller, a number of ruts are made at the distance of from eight to ten inches apart, over the whole of which, the seed is sown broad-cast, and swept into the hollows by a bush-harrow. In this way wheat has been raised on light lands, where otherwise it would have been impracticable*.

There is another mode of cultivating wheat in rows, called "*ribbing*†," which merits particular attention. As soon as the ground is properly prepared, it is made up into small ribs, by a single-horse plough. The seed is then sown broad-cast among the ribs, or a person with a barrow-drill, goes along every rib, and drops the seed along the bottom, which is covered by a light harrow, drawn straight up and down the ridge. In either case, the plant makes its appearance nearly at the same time above ground; nor is there any difference, in this respect, between the two systems. The mode of ribbing is a simpler process than that of drilling;—it may be executed in worse weather;—the expence of a drill-machine is saved;—and the crop may have all the advantages of hoeing, as if it had been drilled‡.

To those, however, who are accustomed to *plough-in* their seed, the drill-barrow, either attached to the plough, or fol-

* A machine is invented by "*Plenty*," an agricultural engineer, which operates by *pressure*, and makes two drills at once, by one horse, which is likewise well calculated for light soils.

† The mode of ribbing wheat, first occurred to the Rev. Adam Dickson, in the course of his examining the Husbandry of the Ancients.—He describes the first trial of it, in the following terms: "A field having been prepared for the seed-furrow, was ribbed across, each rib being formed by one *bout*, or veering of the plough, throwing two furrows upon, or towards each other. In this situation the field was sown, and the corn appeared in distinct rows, at about 14 inches distance the one from the other. The field was twice hand-hoed, and produced a very good crop."—*Dickson's Husbandry of the Ancients*, vol. i. p. 523, note.

‡ Mr. Morton, of Leith-Walk, Edinburgh, has a machine in contemplation, by which several ribbs will be made at once, and the process will be rendered nearly as expeditious as drilling.

lowing it in the furrow, pushed on by a boy*, WOULD AT ONCE ESTABLISH THE ROW-CULTURE, WITHOUT DIFFICULTY, AND WITH LITTLE EXPENCE, OVER AN EXTENSIVE TRACT OF CULTIVATED LAND IN ENGLAND. The advantage of this simple improvement, can hardly be sufficiently appreciated.—*Annual* weeds would be extirpated, and root weeds checked;—and without dwelling on the immediate advantages of the system, the observation is perfectly well founded—" Were it even admitted, that drilled crops are not at first superior to the broad-cast, (the contrary of which has been found in numerous instances), yet in a succession of years, the progressive effects of constant hoeing, will render the drilled ones greatly superior†."

The cultivation of culmiferous crops *in rows*, may therefore be justly accounted, the best method hitherto known, of raising crops of corn; and by promoting, at the same time, the destruction of weeds, of preserving the fertility of the soil.

It is an additional reason for recommending drilling, that it would lead to habits of accuracy and neatness, in all the other branches of arable culture; whereas broad-cast sowing, encourages those slovenly practices, which still prevail but too generally in farming concerns. There is every reason, indeed, to believe, that the system would become general, were it once admitted to be *an established maxim*, (which the information above detailed, sufficiently justifies), that drilling corn, like drilling turnips, was superior to broad-cast. Farmers would then prepare for it, by furnishing themselves with the necessary implements, and by dressing and cleansing the soil, with peculiar and minute attention. There might still be some exceptions, as on very strong clays, or in very unfavourable seasons; but these exceptions, as in the case of drilling turnips, would become every day less numerous. Our fields would then be cultivated with the same regularity and neatness as our gardens, and would become equally productive.

On the whole, such is the importance of the drill system, that its general adoption ought to be promoted, as far as is practicable. Models or engravings of the simplest, and best machines, and directions for their use, ought every where to be circulated, and liberal encouragement given to those, who

* In the Appendix, will be found, an account of the advantages of the drill-barrow, accompanied by an engraving and description, by which any workman, accustomed to agricultural machines, will be able to make one.

† Young's Essex, vol. i. p. 100. By destroying weeds, the nourishment they would have absorbed, is preserved in the soil.

will prove, by accurate experiments, in districts where it is at present either entirely unknown, or but little practised, the utility of the system, and the profit to be derived from it. By the extension of drilling, inferior soils might soon be rendered nearly as productive as those naturally more fertile. In many cases, also, by the introduction of this system, naked fallows might be abolished, where at present they are unnecessarily practised; and by these means, a treasure of solid and permanent wealth, in useful and valuable produce, might be rapidly spread, over the whole surface of the country*.

4. *Dibbling.*

This process has been already described, Chap. II. Sect. 7, p. 124. Its recommendations are, 1. That only one ploughing is necessary;—2. That the seed is regularly deposited in the heart of the flag, where it feeds on the vegetable matter turned underneath, without any assistance from the subsoil;—3. That in common with the other branches of row culture, it may receive all the advantages of hoeing;—4. That there is a great saving of human food from the lesser quantity of seed used†;—5. That it furnishes young labourers with employment, and thereby inures them to in-

* The following are the Resolutions on the subject of Drilling, which the Author moved, at a great agricultural meeting held at Holkham in July, 1819, where they met with the cordial approbation and concurrence of above 500 practical farmers there assembled:

Resolved, 1. That the drill, or row system, is admirably calculated for the culture of leguminous and other crops, not strictly culmiferous, exposing more surface to atmospheric influence; carrying off, where the ridges are raised, any superabundant moisture in wet soils; and admitting the soil to be cleared of weeds in the simplest manner, and at the smallest expence; while the several plants cultivated, are benefited and improved by the repeated stirrings given to the soil, during the several processes.

2. That the drilling of culmiferous, or corn crops, when conducted with skill and attention, is a practice highly meritorious, as the seed may thus be deposited in the soil at the most desirable depth, and of an equal depth, by which the growth of the crop is considerably promoted; and as the crop can afterwards be improved in its progress to maturity.

3. That on all lands where weeds are abundant, corn crops may be drilled with peculiar advantage, for the purpose of cleansing the land more effectually, and at a cheaper rate, than hand-hoeing and hand-weeding broad-cast crops. That lands of moderate or inferior quality, will thus yield a greater produce, and may be brought more nearly on a footing with fertile land, than under the broad-cast system. Hence, that drilling corn crops, in such soils, cannot be too strongly recommended, as a most important national object.

† Dibbling is much practised in China, with a view of saving seed; and it is said in a recent publication, (Storch's Cours d'Economie Politique, vol. iv. p. 72, and vol. vi. p. 15), that the saving thus effected in China, would feed a large proportion of the people of England.

dustry;—and, 6. That the treading of the labourers employed in the operation, is favourable to production *in light soils*. It is certainly an advantageous mode of planting wheat, upon a one year's layer, on light and moderately deep soils; but it never can become a general practice in other cases. In tenacious soils, it does not answer, as the dibble forms a pan for the water, in which the seed perishes*. It likewise occasions more expence than the other process of semination;—and, owing to the greater hurry and fatigue of the children employed in it, and sometimes from a desire of making higher earnings, is often imperfectly performed. Nor can it ever be extensively carried on, unless where the population is very considerable.

The dibbling of pease has been practised from time immemorial in Norfolk; and dibbling beans is not uncommon in that county, and several other parts of England†. In Middlesex, the beans are all dibbled in rows, and the pease are put in by hand-hoes‡.

5. *Transplanting Crops.*

This mode of propagating grain, though long known in the philosophic world, has not hitherto attracted the attention of the practical farmer; yet it is considered by an eminent philosopher, to have a great advantage over the drill husbandry, as the root-scions can be divided, and consequently their crowding each other may be prevented. As there is a wonderful increase of produce in this way from a single pickle§, a prodigious multiplication of the stems of wheat, or of any other grain, may be effected, by transplanting them three or four times in the summer, autumn, and spring, after they have been sown.

The effect of these operations, will appear in a striking point of view, from an experiment tried by Mr. Charles

* Young's Essex, vol. i. p. 272.

† Derbyshire Report, vol. ii. p. 98, and 133.

‡ Middlesex Report, p. 190, 195.

§ Darwin's Phytologia, p. 291. See also, Bogle's Essay in the Papers of the Bath Society, vol. iii. p. 494, and a Treatise on the Culture of Wheat, 1 vol. 8vo. printed anno 1812, p. 225. The plants from a peck of seed per acre, would be sufficient. The plants should be set at about five inches apart, in drills 14 inches asunder,—rolled with a moderate sized machine,—horse-hoed when weeds appear, and afterwards earthed up with a double-mould plough. The produce, when skilfully done, was at the rate of 44 Winchester bushels per statute acre, and the grain was plump and heavy. Ditto, p. 228. In the Monthly Review for July, 1796, p. 329, there is an account of a curious experiment in the transplantation of wheat.

Miller of Cambridge, and recorded in the Philosophical Transactions*.

Dr. Darwin states a number of advantages which may be derived from this system†; and Mr. Bogle, who has paid particular attention to the subject, observes, that he has known instances of wheat, being transplanted in September, and thence monthly to the middle of May, which have all answered extremely well.

This mode of propagating grain, should be kept in view on two accounts; first, that any valuable species of wheat might be more rapidly increased; and, secondly, in case of any *very great scarcity*, transplanting would be by far the most effectual means of saving seed-corn. Besides, though it may not become a general practice, yet in cases where the ground is not regularly covered, a farmer may always find some places in his fields, whence plants may be drawn, without doing any injury; and the crops may thus be rendered, not only more regular and uniform, but also more abundant, and of a better quality, than where the vacancies are filled with spring wheat‡.

The experiments tried by Mr. Falla of Gateshead, near Newcastle, in Northumberland, by which spade cultivation is united to transplanting crops of wheat, are highly satisfactory. The length of the plants, and the size of the heads, astonished every person who saw them, and the produce was at the rate of sixty-eight bushels per statute acre, though from five to six bushels were lost from the crop being shaken by the wind, and preyed on by the birds. By this plan, numbers of the unemployed poor might be provided with work, and enabled to raise their own subsistence.

The transplanting of the Swedish turnip, is an excellent practice, which has succeeded in Cheshire, Derbyshire, and Herefordshire, and is found to answer, both for cleaning the crop more perfectly, and raising a greater produce. The seed is sown in the latter end of April, in a garden. If the weather be favourable, the turnips are ready to be transplanted early in June; sometimes, however, it is

* Vol. lviii. p. 203.—It is said, that one plant, frequently re-planted, ultimately produced 576,840 grains or pickles.

† Phytologia, p. 290.

‡ A successful experiment of transplanting wheat, was tried in Essex, an. 1797, taking up plants where they were too thick in a field, and dibbling them where too thin. *Essex Report*, vol. i. p. 282.—It was done in May, but would probably have been still more successful if executed in April, when the season was wet.

protracted, owing to the season, until the middle or end of July. The land is manured, and prepared, as if for drilled turnips; and the plants are set from twelve to eighteen inches apart in the row: the greater the distance, the weightier in general is the crop. The transplanted Swedes, are afterwards treated in the same manner as the common drilled. When transplanted, it is of use to dip the roots in dung-water. The produce is from 20 to about 30 tons per statute acre. But it has been remarked, that though transplanting might be expedient when the seed was scarce, the practice has become less necessary, since the seed has become more abundant; and that a crop of Swedes, raised from the seed, and not transplanted, often exceeds 30 ton per statute acre.

Sect. XII.—*On Hoeing.*

This is a mode of tillage, which is performed during the growth of a cultivated crop, and its object is, both to improve the present crop, and to prepare the ground for the succeeding ones.—It is certainly of much use, by breaking up the surface, if it has become encrusted;—by promoting the admission of air, and of moisture into the soil;—by improving its texture;—by preparing it for the reception of grass-seeds;—and by counteracting that tendency to weeds, in all tilled and corn-bearing ground, which, from their prevalence in the country around, or from their seed-roots lodging in the soil itself, must be as invariable as the return of the year. This process, however, can never supersede the necessity of thorough fallowing, where root-weeds do much abound*.

Tull, and his disciples, considered hoeing, as more beneficial than common tillage. They contended, that land, when cultivated by the plough, soon begins to coalesce; whereas hoeing, always keeps it in a loose and pulverised state: hence, by hoeing, that the plants are kept moist, even in dry weather, their roots being nourished, by the dews which are absorbed, in proportion to the fineness of the soil; and that plants, which would flourish and grow strong in fine ground, are starved if the soil is hard and crusty†.

* Coventry's Discourses, p. 71.
† Sir John Anstruther's Remarks on the Drill Husbandry, p. 91.

It is now, however, ascertained, that hoeing is a process, which, in moderation, is useful, but which is hazardous, if carried to an extreme. It is of use, when plants are young, for the reasons above detailed; and if, in the course of the operation, the roots of the plant are injured or destroyed, there is vigour enough in it, *when young*, to replace what has been lost, and to repair the mischief. But if the hoeing takes place when the crop is more advanced, the new roots are less efficient, the growth of the plant is hardly perceptible, the increase of bulk is slow, and the ripening becomes irregular. This brought drilling into disrepute, while hoeing was indiscriminately practised; and hence the opinion delivered by the late celebrated Arthur Young, "That those who have made careful experiments, have determined, that equi-distant drilling, *hoeing only while the plants are young*, is superior to broad-cast*."

In cases where it is necessary to employ the hoe, for the destruction of weeds, when the crop is more advanced, the earth should be moved at a greater distance than in the first instance; and in all cases it is necessary to be cautious, in regard to hoeing rich soils, otherwise the crop will be apt to rise in a weak state; if heavy rains take place, it will be lodged, the quality will be inferior, and the quantity considerably less.

Sect. XIII.—*Of Treading.*

After the seed is sown, treading the surface, is a practice that has been strongly recommended *on light soils*†.

In some districts of England, it is usual either to fold the sheep on the ground sown with wheat, between the sowing and the coming up of the crop, or to drive the flock repeatedly over it, at that juncture; in order to give firmness to

* Communication from the late Arthur Young, Esq. (dated Bradfield-Hall, Sept. 9, 1818), to the Author. Duckett considered hoeing necessary for the object of destroying weeds, but often hurtful in the application. If done on a sandy land, in hot sunshine, it would prove highly injurious to the crop. Where the soil is *hard* and *dry*, there is less risk of injury from the operation.

† In Flanders, where the minutiæ of agriculture are so much attended to, it is not unusual, to tread fields of a moderate size, by the human feet; but this plan cannot be carried to any great extent.—The superior sample obtained from the dibble, compared to the drill, is by some attributed to the additional solidity the land receives from the treading of the children employed in the operation.

the soil, and greater stability to the crop. By this means, wheat may be raised on land, which is, naturally, too loose in its texture, for the profitable production of wheat*.

Some farmers, on light soils, prefer pigs for that purpose, as better calculated for the process than any other animal, from their great weight, compared to the size of their feet†. But in West Sussex, the lighter soils, in dry seasons, *are trod by the plough horses*, when turning the seed-furrow. Three plough horses, instead of going at length, draw the last made plough furrow a-breast, and thereby tread or compress the line of soil they are turning‡.

The advantages of treading, as more effectual than even rolling, in destroying the larvæ of insects, and preventing the harbouring of vermin in the soil§, cannot be questioned. It may likewise contribute to check the vegetation of weeds;—it prevents evaporation;—and it is found, that the crops on land thus trod, are not liable to be rusted. It is certainly most applicable to dry light soils; but even in wet ones, when it is impossible to roll the land after it is sown, owing to the wetness of the season, it may be trod afterwards by sheep.

Sect. XIV.—*Of Culture while growing.*

Where husbandry is either imperfectly known, or carelessly practised, farmers are too apt to leave their crops almost totally neglected, from the time they are sown, until the harvest commences. Any mark of their attention, principally consists in pulling up docks, or cutting down any thistles, that make a prominent appearance, as they know well, if they were left in the ground, that it would render the harvesting more difficult and expensive; but

* Marshall's Southern Counties, vol. ii. p. 329.

† Bedfordshire Report, p. 373.

‡ Marshall's Southern Counties, vol. i. p. 174.—He adds, that the advantages of this practice are so great in light soils, in dry seasons, that it would be worth while, in many cases, to be at the expence of an additional horse and driver, in countries where two horses a-breast are the ordinary team, to have the land thus compressed.

§ Treading by sheep, or other stock, would be a more effectual mode of destroying slugs, or the wire-worm, than even rolling. The head-lands, upon which the horses have turned, and where the earth is compressed, are in general free from damage. It is in hollows, therefore, where the slug is sheltered and breeds, and the remedy is to be found, *in pressure*, either by a heavy roller, or, still better, by the tread of animals.

where the drill system does not exist, careful weeding is by no means so general as it ought to be*.

In Essex, the greatest pains are bestowed to hand-hoe wheat. Five shillings per acre, are very generally expended; 20*s.* is not uncommon; and sometimes it reaches 1*l.* 11*s.* 6*d.*† and even more. The operation is frequently done twice, and occasionally thrice, when necessary. The hoes are powerful, and make a great impression upon the ground. The plants at first look sickly after it; but they soon recover, and are greatly improved by the operation. If executed too late, drought gets access, and does evident mischief; but if executed early, and especially where the plants are thin, it is very beneficial, in a considerable degree thickening and improving the crop‡.

The process of hand-hoeing broad-cast crops of wheat, is likewise conducted in Gloucestershire, with great attention and success; in the Vale, and forest districts in particular, few farmers hoe less than twice, at an expence of 7*s.* 6*d.* per acre. The first hoeing is begun as soon as the weather permits in April; the second follows soon after, and must be completed before the crop tillers, otherwise the stalk will be exposed to injury, and liable to be bent or broken. The hoes are in general from five to six inches in the plate, and have the corners rounded off. It requires much attention, and a quick eye, to stir the surface well, and to avoid the destroying too many plants, as well as to leave the rest at proper distances; and this must be ascertained by the nature of the crop, and the fertility of the soil. If the plants are left to crowd each other, the heads will be small; on the other hand, should a greater distance be left, than at first sight may seem desirable, if the land is in good condition, the plants will have room to tiller, and the heads will be larger and more productive. On an average, about six inches between the plants, are thought

* This observation is very applicable to the Irish farmer, who seldom attends to *minutiæ* in any branch of his business. This is a very unfortunate fact, as it is by attending to minor matters, that the husbandman, and even the cottager, derive their principal sources of profit. It is in vain to cultivate well, if the corn is not afterwards attended to, and protected from trespass; neither of which, the Irish farmer thinks of doing effectually. Generally speaking, the industrious and assiduous husbandman, will find a source of emolument by attending to objects, from which the indolent and ignorant occupier, would not think of deriving any advantage.—*Remark by Edward Burroughs, Esq.*

† This sum is not to be considered a common expenditure, but a peculiar and extraordinary case.

‡ Essex Report, vol. i. p. 306.

sufficient. The advantages of this practice are great, the weeds which infest arable lands, are generally luxuriant in their growth, and unless checked in their early state, get the better of the more valuable plants that are near them; or, where they are of the creeping sort, they exhaust the nutritious particles in the soil, and by covering the ground, keep up a kind of stagnant moisture on the surface, at the same time excluding atmospheric influence, and the animating influence of the sun. The effect of this attention to the destruction of weeds, is experienced in the produce, the return being from 20 to 30, and on high conditioned lands, 40 bushels of wheat per acre*, a considerable proportion of which is attributed to the crops being so carefully hoed.

This practice has been deservedly celebrated. In general, crops remain in a state of neglect from seed-time to harvest; whereas, in the Vale of Gloucester, the business of the arable process, does not seem to be set about in earnest, until the crops get above ground. By means of this attention to the crops *while vegetating*, many extensive common fields in Gloucestershire, have been cropped year after year, from time immemorial, without the intervention of a fallow; and thence have obtained the name of "Every Year's Land." It is a maxim in this district, however, that pulse and corn shall be grown alternately. The hoeing is chiefly performed by women and children, industry is encouraged, the poor-rates kept down; and both the farmer and the public are essentially benefited by the process†.

When a dry spring succeeds a wet winter, the surface of strong land is often rendered so hard, and crusted, as to exclude the air, and by confining the seed, to prevent the due evolution of its parts. The roots of the corn, being unable freely to penetrate into the soil, the wheat assumes a yellow and sickly appearance;—a diseased state, which may, and ought to be cured, by harrowing the wheat moderately, and immediately rolling it‡.

Another useful practice, during the process of vegetation,

* Gloucestershire Report, p. 115, &c.—Similar practices are adopted with success in several other districts. Perhaps were more attention paid to the preparatory processes, or, were the fallowing system adopted, there would be less occasion to work the land, after the crop was above ground. But above all, by the adoption of the "*Drilling system*," such tedious processes might be avoided.

† Marshall's Gloucestershire, p. 91, and 100.

‡ Middlesex Report, p. 213.

and which is extensively practised in various parts of England, is, that of top-dressing the growing crop, when it is suspected, that the land is not rich enough to bring a full crop to perfection. This should be done early in the spring, when the land is sufficiently dry to bear the treading of horses, without poaching. After the manure has been applied, the land should generally be harrowed and rolled. Soot, ashes, and other light manures, are thus most advantageously made use of.

Sheep are variously employed during the process of vegetation. In some parts of England, they are turned into crops of beans, to devour the weeds, and they leave the beans untouched.—They are frequently folded on fresh sown wheat, which requires treading*.—When the crop is likely to suffer from the grub or wire-worm, turnips are spread upon the surface, and a flock of sheep brought to eat them, by which the vermin have been destroyed†.—When the crowns of the roots of wheat, are exposed in the spring, two or three inches in length above the mould, the treading of sheep, after a moderate shower, will frequently force the wheat into the moist ground, where it will produce fresh roots‡.—To check the luxuriance of wheat in spring, and sometimes to force the roots to throw out a greater quantity of collateral shoots, wheat is often fed in spring; but it ought not to be continued later than April§. Nay, in seasons particularly favourable to the growth of wheat, when it has become rank in autumn, the experiment has been tried, of turning in a flock of sheep, to check its growth; but they ought not to be kept longer, than merely to eat off the more luxuriant leaves‖. In France, they feed their cattle in spring, on their young wheats, without any injury to the crop; and sometimes, when the crop is over luxuriant, the scythe, or the sickle is applied.

* Middlesex Report, p. 213.—On the naked chalk soils about Dunstable, this is beneficially practised with sheep, and sometimes with swine.—*Bedfordshire Report*, p. 373.

† Herts Report, p. 85.

‡ Middlesex Report, p. 213.

§ Bedfordshire Report, p. 374.

‖ Gloucestershire Report, p. 115. Some sorts of sheep, particularly wedders, do not agree with such succulent food as young corn.

Culture of Beans while growing.

A circumstance of great importance with regard to the management of beans, has recently become the subject of much discussion, and may prove highly useful to the cultivator of that crop. It is well known, that beans are an excellent preparation for wheat; but it was often so late before the crop could be cut down, and carried to the stack-yard, that the season for sowing the succeeding crop to advantage, was lost. The injury thence likely to be incurred, may be diminished, if not prevented, by a simple expedient.

It has long been a practice with gardeners, to cut off the tops of beans, in order to accelerate their podding. From its success in the garden, it was natural to suppose, that it would answer in the fields; and some experiments were made in different places, to ascertain that fact*. It was never, however, much attended to; and as it has probably been tried on the greatest scale, by John Lowther, Esq. Member for Cumberland, it may be proper to give the following account, of the origin and progress of the system, on his farm, as communicated to the Author.

His bailiff, George Lane, who had been a gardener, was instrumental in applying the garden culture of beans, to that of the field, and hence the practice of cutting off their tops originated with him. It was begun about the year 1804, and has already been tried on more than 200 acres. The operation is performed by means of a sharp-edged instrument or knife, 12 or 14 inches long, exclusive of the handle; but it may be done by a sickle or reaping-hook. The expence has never exceeded 3*s*. per acre, and it is done by contract. At a certain stage of its growth, the head of the bean-stalk does not seem essential for the purposes of vegetation, but by its luxuriance, to exhaust the strength of the plant. The proper time to cut off the top is, when the first blossoms begin to drop; if done sooner, a fresh shoot will put forth. As soon as the tops are cut off, the pods rapidly increase in size, and the period of ripening is accelerated. The timely removal of those parts where the

* It was tried more than forty years ago in Oxfordshire.—Mr. John Blackwall, an intelligent farmer in Derbyshire, has long practised this mode with great success. *Report*, vol. ii. p. 133.—The same plan of topping, may be extended to pease, with much advantage, for the purpose of accelerating their ripeness.

insects chiefly lodge, materially contributes to the health and vigour of the plant, and probably increases the weight of the crop. The harvest is by this means advanced *at least* a fortnight*. In the ordinary mode of managing a bean crop, their tops are green when reaped, consequently they absorb and retain moisture, and require a considerable exposure in the field, to prepare them for the stack; whereas, without their tops, the crop is sooner in a condition to be carried, and less risk is incurred, from the effects of frost and wet seasons.—The tops are left to rot upon the ground. The loss of some fodder, and the trifling expence, are the only objections that can be urged against the practice. It is peculiarly calculated for the drill system, all the plants not being otherwise accessible; and it furnishes an additional reason, in support of that superior mode of culture for pulse crops.

In the General Report of Scotland†, in which this process is briefly noticed, an old scythe-blade, set in a wooden handle, is recommended; and the expence is only estimated at about one shilling per acre; but even a much greater expence, is not to be put in competition with the advantage of having the crop ready for the sickle, a fortnight earlier, and perhaps an additional week gained in the drying of the sheaves. Where reaping-hooks are in use, this operation may be easily and accurately performed by that implement.

The other improvements to be afterwards detailed, in the reaping, and the harvesting of beans, in addition to that of drilling already mentioned, have brought the culture of that plant to such perfection, as to render it a much more advantageous preparation for wheat, than it has hitherto been considered.

* Nothing, perhaps, would be of more importance, in the cultivation of the clay soils of Britain, than a variety of beans, that would ripen a month or six weeks earlier than the present kind. It would be useful to see some account of any trials that have been made for that purpose. Mr. Burrell, Member for Sussex, and Mr. Stone of Basildon, in Berks, strongly recommend the Heligoland bean, as both early and productive, and more easily harvested in a wet season. By others, the superiority of this bean is disputed.

† Vol. i. p. 522.

Sect. XV.—*Of Reaping.*

Experienced husbandmen think, that wheat should be cut down some days before it is fully or dead ripe*. As the grain hardens well in the sheaf, and the sample is often better. The harvest thus begins earlier, and its labours are more equally distributed†.

Barley ought likewise to be cut before it is too ripe, otherwise the straw becomes brittle, which occasions much loss by the heads breaking off.

Though oats are reckoned a hardy grain, yet the more early varieties, being liable to damage from high winds, or from exposure to much wet, ought to be cut as soon as they are nearly ripe, in order to lessen the risks to which they are exposed‡.

Beans should be cut down, as soon as the eye has attained a deep colour, and if the weather be dry, made up as soon as possible, into sheaves. The straw will thus be of triple value, and the grain of superior quality§.

Where the crop is lodged, whatever may be the state of ripeness, it should be immediately cut down; more especially if grass-seeds have been sown with it, which may otherwise be lost‖.

The nature of the instruments for cutting down the crops, is the next point to be considered¶.

* Mr. Coke cuts down his wheat very early, even when the ear and stem are greenish, and the grain not hard. He says that the wheat, thus early reaped, is always his best sample, and he gets 2*s.* a quarter for it more than for wheat cut in a more mature state. He perhaps, loses something in the measure, the skin being thinner, and the grain probably, not quite so bulky; but, if this be true, it is fully compensated from his suffering no loss by shedding on the ground, which, when the ear is ripe, and the weather windy, is often not inconsiderable.—*Dr. Rigby's Report*, p. 29.

† Brown's Rural Affairs, vol. ii. p. 310.—Young's Calendar, p. 420.—Whenever the greater proportion of the crop is fully ripe, no delay in cutting it should take place, more especially if the season is advanced, or the corn is in a high and exposed situation. In such circumstances, the green may never ripen, and the ripe may be lost.

‡ An experienced farmer, the late Mr. John Shirreff, recommended, that all sorts of grain should be cut, whenever the straw immediately below the ear, is so dry, that on twisting it, no juice can be expressed; for then the grain cannot improve, as the circulation of the juices to the ear is stopped. It matters not that the stalk below is green. Every hour that the grain stands uncut, after passing this stage, it is attended with loss.

§ Paper from Mr. John Shirreff; Comm. vol. iv. p. 172.

‖ Curwen's Report, p. 72.

¶ Sometimes the crop is pulled up by the roots, where long straw is much wanted, as is the case in the western counties of England; and beans are occasionally pulled, where the pods are lowly situated. But these practices are considered to be tedious and expensive.

Various plans have been devised for that purpose, as, reaping by a sickle, or reaping-hook;—mowing by a scythe;—and *bagging*. The plan of cutting down corn by machinery, though it has made some progress, has not yet been brought beyond the line of partial experiment.

1. *Reaping by the Sickle, or Reaping-Hook.*

For districts in which a sufficient number of hands can be procured, reaping either by the sickle, or the reaping-hook, are excellent modes of cutting down the crop, if attention is paid to low cutting. With careful reapers, there is very little waste;—the heads of the corn are all put in regular order;—and the crop placed in a position favourable to threshing, either by the flail, or by machinery.

The sickles are jagged on the edge with teeth; but reaping-hooks are ground sharp and smooth. The former is preferred in those districts where the practice of *bagging*, (to be afterwards explained), has not been introduced. The teethed sickle, requires but little sharpening;—it has the advantage of keeping the corn better together;—and in careless hands, some of the heads are cut off and lost, in using the sharp reaping-hook, when it enters among the crop, before the reaper has gathered the corn with his hand*.

Reaping by the sickle is performed by the day;—by the acre;—by the harvest season;—or by the work that is executed, for instance, a certain sum for any given number of sheaves. Of these modes, the one *per acre* is the most advantageous, where the practice can be introduced.

It is a most essential object, to cut the crop very low, that any waste of straw, or loss of grain may be prevented. The additional quantity of grain thus procured, will pay the expence, and the increased quantity of muck is mostly clear profit; because mowing the stubbles afterwards, imperfectly supplies the place of close cutting in the first instance.

Cutting corn when wet, ought to be avoided, for when put up in a damp state, in a close sheaf, it cannot get dry. In bad harvests, the sheaves ought to be *gaited*, that is, set up single, loosely tied near the ear-ends of the

* An improved implement for cutting corn, one half from the point, hacked like a sickle, and the remainder smooth and sharp, was invented by Mr. Joseph Hatton, junior; and effecting a great saving of corn, has had a considerable sale.—See Transactions of the Society of Arts, vol. xxviii. p. 54; Derbyshire Report, vol. ii. p. 122.

straw, and spread out circularly on their *butts*, or ends, to give them a firm standing.

The sheaves ought to be of a moderate size, not exceeding nine inches in diameter, or thirty inches in circumference. In wet seasons, from six to eight inches in diameter is quite enough, and instead of binding with two lengths of the corn made into a rope, one is sufficient; nor ought the knee to be applied, when the sheaf is bound, as the air is thereby too much excluded. The binder's arm will compress the sheaf as much as it ought to be, provided the size be such as is here recommended*.

It is calculated, that three good reapers will cut down an English acre, and that one man will bind, and put into shocks or *stooks*, two acres per day. The expence of these operations, varies from 10*s*. to 16*s*. per English acre. Taking all charges into consideration, if the crop be good, and the reaping process be duly executed, the farmer has no reason to be dissatisfied, if he can get it done for about 15*s*. per statute acre.

2. *Mowing by the Scythe.*

This instrument is frequently made use of for cutting oats and barley; and in some districts of Kent, it is even used for wheat. It is either plain, or furnished with a bow, or cradle, to assist in laying the heads more regularly in one direction. The late celebrated George Culley maintained, that this was the completest mode of cutting down barley; that when properly mown, it could be neatly tied up in sheaves, and could be threshed without difficulty by a machine. Whenever the crop, however, is much lodged, or irregularly broken down, or interwoven by squalls of wind, or heavy rains, the scythe cannot act with efficacy, or even with safety. The use of the scythe, therefore, is only admissible, when the corn stands upright, or with a regular inclination, or nearly so, in one direction†. But the use of the scythe is objected to on the following grounds: 1. When clover, or any other grass, has been sown with the crop of corn, the scythe will cut nearly all the grass that has grown, which, mingled with the stems of the corn, in so large a proportion, must render the harvesting extremely hazardous. 2. It is more difficult, with such a load of grass, to

* Gentleman Farmer, p. 161.

† General Report of Scotland, vol. i. p. 384.

put the crop in shocks, or stooks, and the operation is more wasteful; and, 3. The crop cannot be so easily, or so safely stacked*.

A comparison has been made, between the expence of reaping by the sickle, or cutting down by the scythe. By the sickle, it would cost about 12*s*. per English acre, for barley, and 15*s*. for wheat. By the scythe, it will be cut down at least 2*s*. cheaper, and with from two to four additional inches of straw, the manure from which, will be worth from 4*s*. to 7*s*.† It may be added, however, that it is practicable to obtain nearly as much straw, by the sickle, as by the scythe, provided the farmer is disposed to bestow the necessary time and attention to the conduct of his reapers, and will give them a moderate addition to their wages, when the work is properly executed.

3. *Bagging.*

This is a practice, principally confined to the counties of Middlesex and Surrey, where it has been adopted, with a view of securing an increased quantity of straw. This it does, to the amount of from 4*s*. to 7*s*. per acre. In Devonshire, the crops are chopped down, in a similar manner, so as to leave hardly any stubble‡. It is done by a toothless reaping hook, of about twice the weight of a common sickle, which is sharpened as often as is necessary. The operation is performed by cutting the crop down by a succession of blows, made within two or three inches of the ground. It is, in fact, mowing with one hand, against the standing corn. By bagging, the straw is cut much closer to the ground, than is generally done by hand-reaping§. There is little or no difference of expence between bagging and common sickle reaping, whilst it is equally expeditious. Beans are usually *bagged* as well as wheat. The expence of bagging, is generally about fifteen shillings per acre; but it varies from twelve to twenty shillings, according to the bulk and condition of the crop||.

* Remarks by Edward Burroughs, Esq.

† General Report, vol. i. p. 386. A crop of oats, if abundant, takes longer time to cut with a sickle, than a crop of wheat, if it is cut low; there being more handfuls of oats, than of wheat.

‡ Devon Report, p. 142. It is said, that in some parts of England, barley may be mown, at from 3*s*. 6*d*. to 5*s*. per acre; but that is independent of tying.

§ Middlesex Report, p. 152.

|| Surrey Report, p. 215.

It would appear that the mode of reaping, as executed by Welsh labourers, in the counties of Hereford and Salop, is the most perfect, and the cheapest, of perhaps any hitherto known. It is performed by an instrument, a little longer than the common sickle, and about double the breadth; it has no teeth, but is sharpened like a scythe. This sickle is known by the name of the *Cardigan hook*, which may be purchased at Ludlow, and all other towns in that neighbourhood, for 2*s*. 8*d*. each. With the hook, a whetstone is bought for 3*d*. This mode of reaping is equally applicable to wheat, barley, oats, beans, and pease.—The reaper bears up what he cuts against the standing corn, with one arm and leg, pushing it before him, until he gets about half a sheaf. It is cut down close to the ground. In the harvest of 1818, the common price given, was 4*s*. 6*d*. per statute acre, the employer finding food, drink, and lodging; but when these are not furnished, the usual price is, from seven to eight shillings per acre for wheat; and for that sum, the reaper not only cuts, but binds up the grain. The general adoption of so useful a system cannot be too much recommended*.

The Flemish mode of cutting grain, by a stick with an iron hook, and a short scythe, has been already described†. It is only a small deviation from bagging, and is said to be a most expeditious mode of cutting grain.

Sheaf Bands.

In the Isle of Thanet, they have an excellent practice, of preparing, at leisure times, bands of straw, which are carried by children to the field, and given to the workmen when wanted, for tying up the corn. Where there is a threshing-mill, this can easily be effected. In this way, the band may be made of any required dimensions, the waste of much corn is prevented, more especially when the crop is ripe, less time is wasted in reaping, and there is no risk of the bands growing in wet weather. Even children are thus taught a degree of subordination, and rendered useful in carrying on

* Communication from Mr. John Hope, a native of East-Lothian, to the Author. This shews the advantage of minute and extensive inquiries. One would not have expected, that so perfect a system of reaping would be practised, by the natives of a remote and mountainous district, as that of Cardigan. See also the Herefordshire Report, p. 49.

† Chap. II. p. 110.—It was described as far back as the year 1763, in the Gentleman's Magazine, p. 528.

the business of the farm, without being subjected to labour above their strength*.

Sect. XVI.—*Of Harvesting.*

Corn, when cut down, is usually put into sheaves and *shocks*, (provincially *stooks*), or two rows of five or six sheaves each, with two more spread open on the top, for protection against rain, called the *hooding*, or head-sheaves. In wet seasons, the crop is sometimes put into small stacks in the field, where it remains, till it be fit to be removed to the stack-yard. The expence, when the work is properly conducted, is not considerable, and the corn is put out of risk. By making the stack in the centre of the space from which the corn is to be carried, the operation goes on very quickly. In one day, in the precarious harvest of 1816, an eminent farmer in East Lothian†, secured, in this way, thirty-two statute acres, in which grass-seeds had been sown, at an expence of about two shillings per acre. Nineteen men were employed, of whom twelve were put to carry the corn upon hand-barrows to the stack, three to build, three to fork, and one to dress the stacks, and to rake up the loose corn. The ground was so wet at the time, that had carts and horses been put upon it, the young grass would have been destroyed. In Cornwall, from the dread of moisture, they are accustomed to put up their corn in small stacks, *the very evening in which their crops are cut down;* and the farmers consider their crops to be perfectly safe, if once put dry into one of these wind, or *arish mows*, as they are called. Each stack contains 180 sheaves, and there are generally three to an acre. Mr. Curwen is accustomed to stack his corn in the field, regard being had to future convenience in its removal afterwards‡.

When corn is sufficiently dry, it is carried§, either into a barn, or stacked in a yard adjoining to the farm offices. The latter plan is preferable, on various accounts. 1. The grain and straw, if put into a barn, must be much drier than is necessary for the largest ricks, and consequently,

* Marshall's Southern Counties, vol. ii. p. 25 and 28.

† Robert Browne, Esq. of Markle.

‡ In one year, he erected 144 stacks in the field.—*Report*, p. 74.

§ The comparative advantages of using carts or waggons, for conveying corn in harvest, has been already discussed. See Chap. II. p. 115.

must be longer exposed to the vicissitudes of the weather. 2. In barns, the grain is peculiarly liable to the depredations of vermin. 3. Corn in the straw, keeps much better in the open air, than in close barns. 4. The expence of constructing, and keeping these buildings in repair, is very considerable.—Few operations at the same time, require to be more scrupulously attended to, than the erecting of corn-stacks, which should not only be substantially done, so as to secure the crop effectually, but neatly executed*.

The old practice, of stacking corn on the ground, in the yard, even though bottomed with loose dry straw, was not a little exceptionable; part of the grain being apt to imbibe moisture, and the whole liable to the depredations of vermin: but now, corn may be preserved in the open air, either in corn-stands built of stone or brick†, or upon pillars made of stone or cast-iron, without receiving the slightest damage. Where cast-iron is accessible, that material is to be preferred, as no vermin can get up so slippery a surface. Seven, or nine pillars of cast-iron, are sufficient for a common-sized round stack, the expence of which, will not exceed from forty to sixty shillings, according to the price of iron‡. The frame of coarse wood, on which the corn is laid, usually costs from eight or ten, to thirty or forty shillings more. The whole amount is often repaid by the saving of the first year.

There is a practice in Scotland, of using what is called *bosses*, which, when joined to cast-iron pillars, has brought the stacking of corn to great perfection. They are thus formed: A triangle is first erected in the middle of the frame, which forms a boss or hollow, about three feet wide: a few spars of fir are nailed across the boss, so close, as to preserve the sheaves from falling into it; but when these cannot be got, a straw rope is commonly used in their stead. After the builder has reached the top of the boss, he places

* Curwen's Report, p. 76.

† See a description of those at Woburn Abbey. Communications to the Board of Agriculture, vol. i. p. 72. When built with brick, the stacks are kept down, and hold more corn in the same height than the other sorts; consequently, they claim a preference in exposed situations. They will not admit, however, the plan of bosses; and are sometimes damp, from the rain water they receive before harvest. To obviate that objection, ricks are sometimes built on solid masses of stone, instead of being hollow.—*Derbyshire Report*, vol. ii. p. 67.

‡ For *ricks*, or long square stacks, the number must be even; the practice of building these, called *wheat-hovels* in Lincolnshire, is very ancient; their posts are of stone, and covered with a stone cap, on which the timber rests.

on it a sack filled with straw, which, when he builds round it, he pulls up, until he reaches the top of the stack. By this means, crops of wheat, barley, or oats, can be harvested with less exposure to the weather, and in better condition. It may be proper to add, that, in very bad harvests, by means of the invention of bosses, one row of sheaves of corn, may be put on the stacks, "*from the sickle,*" (placing the heads of the sheaves to the centre), and may thus be effectually secured—a great object in a wet climate*. When these sheaves are thoroughly dry, others may be added.

Engravings are annexed, for the purpose of giving a better idea, than any description could furnish, of these useful inventions. (See Appendix, Plate III).

The harvesting of beans, being often attended with peculiar difficulties, the improvements which have been made in that operation, deserve to be more fully described. After they are cut down, and put in small sheaves, not exceeding from six to eight inches in diameter, they ought to be immediately conveyed, if intended to be followed by a crop of wheat, to dry in another field, otherwise the season of sowing may be lost. The additional trouble and expence of their removal, is amply compensated, by the difference in value, between a crop of wheat, and that of any other grain. Beans, on this plan, if put in an airy situation, will be sufficiently dry to be stacked on cast-iron pillars, *with bosses*, in ten, twelve, or fourteen days, according to the state of the weather, after they were cut, but always in less time than they would be fit for stacking, if left on the soil where they were raised. By the operations above detailed, namely, the cutting off the tops of beans;—reaping them early;—conveying them to another field to dry;—and stacking them on cast-iron pillars, with bosses, the harvesting of beans may be considerably accelerated, while more time is given to prepare the soil, for the succeeding crop of wheat;—advantages of no common magnitude.

Corn stacks are, in some districts, built in an oblong, instead of a round form; but though these oblong constructions, require less time and labour, and fewer covering materials than the others, yet they are objected to, as interrupting the free circulation of the air in the corn-yards,—being more liable to injury in damp weather,—and, unless

* Husbandry of Scotland, vol. i. p. 373.

carefully placed, more apt to be overturned by wind, than those of a round construction.

Before concluding this subject, it is proper strongly to inculcate the necessity, of unceasing activity, at that critical period when the labours of harvest are going on. Some husbandmen have rarely, if ever, any spoiled grain in their possession; while others, of more tardy habits, are seldom without it. A disposition to trifle or procrastinate, and to rely on the continuance of good weather, is quite unbecoming the character of an industrious and intelligent husbandman; and there cannot be a better criterion, to judge of the agricultural skill and spirit of any particular district, or the management of those who cultivate it, than to ascertain, how the business of the harvest is conducted*.

Sect. XVII.—*Of Threshing Grain.*

The operation of separating corn from the straw, has been recently brought to a degree of perfection in this country, that some years ago, would have been considered as unattainable. The advantages of the new mode, in a general point of view, have been already explained, (Chap. II. p. 124); and it would have been desirable to have given a statement, of the pecuniary profit derived from it, in this place; but such is the diversity of opinion respecting the expence of keeping horses, and such the difference of wages in the several counties, that it was found impossible to make a calculation, that would be generally acceptable, or that would be applicable to more than one or two districts. The average profit from the mill, worked by horses, when compared to the flail, it would appear, is from 3*s*. to 4*s*. per quarter for wheat, from 2*s*. to 3*s*. for barley, and from 1*s*. to 2*s*. for oats; but where oxen are used, instead of horses, or where the machine is driven by water, or wind,

* Coventry's Discourses, p. 85.—The pleasures of the harvest, is thus ably, and eloquently depicted by Mr. Curwen: "I was never absent from the harvest-field an hour from its commencement to its conclusion; for, independently of all other considerations, there is a gaiety in it, which is delightful, and peculiar to itself. The successful termination of the labours of the year;—the recompense of unwearied exertion;—the alleviation of solicitude;—the solace of hope;—all combine, to inspire the liveliest gratitude to Heaven;—to call forth the sensibilities of the human heart, and to kindle the best feelings of nature; whilst the responsive notes of the motley group, reiterate mutual good-will, universal sympathy, and thankfulness to Providence!"—*Curwen's Report*, p. 74.

the expence of threshing by the mill, is considerably reduced, and the advantage comparatively augmented.

If the old plan of threshing by the flail, had continued in use*, the task was so severe and irksome, while, in time of war, labourers fit to perform it, were so scarce, that the expence must have greatly reduced the profit of the farmer, and the value of land†. But the waste of grain from that imperfect mode of threshing, and the pilfering which often attended it, was yet more vexatious; and the labourers could not always be prevailed upon, to thresh the corn wholly out of the straw, *even when they knew that their own families were in danger of suffering from the want of bread*‡. Nor is that to be wondered at. Few men are dexterous at handling a flail; and labourers in general, would rather work without doors, even in wet weather, than subject themselves to the severe, dusty, and unwholesome toils of a barn§.

In the western districts of England, they are desirous of extracting the grain, with as little injury as possible to the straw. For that purpose, the ears are cut off, and threshed separately from the straw‖, which is converted into a species of reed for thatching, or used for litter¶.

Sect. XVIII.—*Of Dressing, or Winnowing Grain.*

The old imperfect modes of dressing grain, either by the action of wind operating between two doors of a barn, or by conveying the corn to the summit of some adjoining eminence, where it was winnowed by a natural breeze, are

* In 1795, owing to the badness of the crop, some farmers paid 10*s.* per quarter for threshing wheat. *Kent Report*, p. 190.—In 1807, threshing wheat, cost in Essex, 4*s.* per quarter. *Report*, vol. ii. p. 371.—In the winter of 1815-16, the price in Surrey was from 8*s.* to 9*s.* per quarter. But the price of labour is so involved with the poor-rates in England, that it is difficult to ascertain its real amount.

† Brown's Treatise on Rural Affairs, vol. i. p. 315.

‡ Middlesex Report, p. 548.

§ Roxburghshire Report, p. 58. ‖ Somerset Report, p. 97.

¶ Devonshire Report, p. 149.—The small mill invented by Mr. William Johnstone, of Langholme, in Dumfries-shire, which costs only from ten to eighteen pounds, would be a most valuable improvement to those western districts; for by it the ears might be threshed, without separating the ears from the straw, merely inserting the heads of the sheaves; and the straw would remain unbruised. This mill is more likely to be adopted in foreign countries, than the larger machines. It is likewise to be had at Gutzmer's, Leith-Walk, Edinburgh. Mr. Silvestre has lately exhibited a hand threshing-mill, which saves the straw whole, and is recommended for its simplicity.

now laid aside. The idea of a winnowing machine, for the purpose of raising wind artificially, is supposed to have originated in China, and was there applied to the dressing of rice. It was thence brought into Holland, and attached to mills for making pot or pearl barley. Its introduction into Scotland, above a century ago, is attributed to the patriotism of Andrew Fletcher of Salton, and the ingenuity of James Meikle, whose son was the inventor of the threshing-mill. But its construction on a larger scale, so as to render it applicable to all sorts of grain, is said to be owing to a person named Rogers, a farmer near Hawick, in Roxburghshire, who, about the year 1733, commenced a manufacture of them, which he and his descendants carried on to a considerable extent*. It is impossible to calculate, to what inconveniences and losses the farmers must have been subjected, before their difficulties were removed by this most useful invention†.

The threshing-mills erected, have, almost in every case, a set of fanners attached to them; and those on the largest scale, are sometimes provided with a second pair, by which the cleaning of the grain, is rendered so complete, as to require little or no dressing afterwards. From the inequality of motion, however, necessarily attendant on so violent an operation as that of threshing, and the additional strength required, which is severe on horses, when they are employed, the second pair of fanners is now generally laid aside; the judicious husbandman, who wishes to secure at market, a character for well-dressed grain, finding it more for his interest, to give the final dressing to his grain, in a deliberate manner, by hand-fanners‡.

By these machines, with the aid of riddles attached to them, all dirt, seeds of weeds, chaff, and other refuse, are separated or blown away, and the grain parted into divisions, according to its quality, by which it is rendered intrinsically more valuable than if the good and the inferior were mixed together; in the same manner as a fleece of wool, fetches a much higher price, when broken or sorted by the wool-stapler.

The thorough dressing of grain, and making the whole stock correspond with the sample produced at market, are important objects for a farmer to attend to. In this way,

* Roxburghshire Report, p. 59. † Brown's Treatise, vol. i. p. 356.
‡ General Report of Scotland, vol. i. p. 409.

all disputes with purchasers are avoided, and the grain fetches its full value. One or two per cent. of bad grain left in the stock, will often lessen the price from five to ten per cent. when the market happens to be dull; whereas the imperfect grain, if dressed out, and given to the farmer's horses, or, if not sold separately, otherwise used at home, would be got rid of to more advantage.

Sect. XIX.—*Improving the Quality of Grain, and Flour.*

When wheat has been injured during a bad harvest, it ought to be put into small stacks, in which state it will dry much more quickly, and be sooner rendered fit for grinding into flour. If large stacks are used, *bosses*, or triangular frames ought to be employed. If stacked in a damp condition, it should rarely be threshed earlier than the summer after it has been harvested, when its condition will be greatly improved.

Wheat, if not in good condition, is much improved by kiln drying; but it should not be ground, (unless in cases of necessity), until some time after it has undergone that operation. It ought to be moderately kiln-dried, with a slow heat, and frequently turned. But if the grain be musty, it ought to pass through a previous process, which is thus described by an eminent chymist.

The wheat must be put into any convenient vessel, capable of containing at least three times the quantity, and the vessel must be subsequently filled with boiling water; the grain should then be occasionally stirred, and the hollow and decayed grains, (which will float), may be removed; when the water has become cold, or, in general, when about half an hour has elapsed, it is to be drawn off. It will be proper then to rinse the corn with cold water, in order to remove any portion of the water which had taken up the must; after which, the corn being completely drained, it is, without loss of time, to be thinly spread on the floor of a kiln, and thoroughly dried, care being taken to stir, and to turn it frequently, during this part of the process*.

By this simple operation, corn, however musty, may be completely purified, with very little expence, and without

* A Letter to the Right Hon. Sir Joseph Banks, Bart. by Charles Hatchett Esq. Printed an. 1816, in 4to.

requiring previous chemical knowledge, or any expensive apparatus. Mere ventilation, however, has been recommended, as a means of preparing grain for use, sufficiently effectual.

When grain is infected by smut, it can be thoroughly cleaned, however black it may be, in the course of three washings, in a wooden tub, resembling a mill for washing potatoes*. The wheat must afterwards be kiln-dried.

It is generally supposed, that if wheat be much injured during a bad harvest, the flour made from it, will not ferment, or bake into loaf-bread, and that it is only fit for distillation, or to be eaten by live stock. But with the aid of soda, the flour may be much improved; and, at any rate, may be made into cakes†, or biscuit, and consumed with safety and advantage. In France, they recommend, in such cases, that the water used in making the bread, should not be so hot as usual;—that the dough should be made firmer, and with a greater quantity of salt;—that the bread should be made into smaller loaves;—that the oven should be more heated;—and the loaves kept longer in it. The more the bread is baked, there is the less danger in using it, and it should, if possible, not be consumed, till two or three days after it has been baked‡.

Sect. XX.—*On Preserving Corn, and Flour.*

In several countries, such as Switzerland, Poland, &c. great labour and expence are bestowed, in storing and preserving corn for times of scarcity. In some places, deep pits are made in the solid rock, and in others, caves are dug in the sides of hills, in which the grain is deposited. Large granaries have been also built of stone, so as to admit of a free ventilation, and a frequent stirring of the corn. But for any moderate period, (say one or two years), there is no mode so advantageous, as the keeping grain in the straw,

* Husbandry of Scotland, vol. i. p. 377.—The corporation of bakers at Perth, have a machine for that sole purpose.

† It may likewise be made into what are called *flour scones* in Scotland, prepared with milk instead of water, a species of bread, which is both good and palatable.

‡ Instruction sur les moyens de tirer le meilleur parti possible des grains cereales, &c. Redigée par ordre du Ministre de l'Interieur, par une Commission de la Societé Royale et Centrale d'Agriculture. *Paris, le* 18 *Juin*, 1817.—The Government of France does itself infinite credit, by its attention to such objects, and the useful information which it circulates.

in a large and well-built stack, properly secured from vermin.

As the straw, however, becomes less valuable the longer it is kept; and as stacks are exposed to the risk of fire, whether malicious or accidental, the discovery of a cheap and effectual mode of constructing a granary, has long been wished for.

Farmers, indeed, seldom incline to have much of their threshed corn on hand at once; but there ought to be, on every farm, places of security, capable of containing a portion of the grain annually produced upon it, in case there should be a deficiency of market. Such granaries, scattered over the whole country, would be the best security against famine that has hitherto been thought of, and being less visible, would not be so obnoxious, nor liable to the same hazards, from popular frenzy, as large stacks, or even well filled barns*.

If there should be any objection to granaries, there is no difficulty in preserving flour, in a manner that would answer the same object. When Buonaparte took possession of Leipsic, prior to the battle which proved so fatal to the French army, he found a number of barrels of flour, that had been kept there for several years, and was in perfect good condition: a sufficient proof that flour, when properly manufactured, and closely packed in good condition, is not an article so liable to injury, or so difficult to preserve, as is commonly imagined. In vessels made of block-tin, and sufficiently hard pressed, it may likewise be kept sound, for a great length of time, and during the longest voyages. The same plan would likewise answer if the cases were made of iron.

* In the first volume of the collection of printed papers, known under the name of "*De Re Rustica*," p. 118, there is an account of a treatise on the construction of granaries, by a Hanoverian architect, called Dinglinger, which merits attention. It is accompanied by an engraving. In the works of Dumonceau, Duhamel, and Chateauvieux, there are descriptions of a ventilating granary, which is much recommended; and M. Descroizilles, *aîné*, has lately published a work at Paris, explaining a new mode of preserving grain, in what he calls "*conservatory towers*," invented by M. Chenest, which has received the approbation of the Royal Agricultural Society of Paris.

Sect. XXI.—*Of the Accidents to which Grain is liable.*

This subject is highly interesting; but in a condensed work like the present, only *a general view* of the accidents to which grain is liable, can be given. These may be treated of under the following heads: Heavy rains;—fogs or mists;—dew;—frost;—hail;—snow;—violent heat;—blights;—calms;—variable weather;—insects;—birds;—and vermin.

1. *Heavy Rains.*—When wheat is in flower, heavy rains will prevent the process of fructification from going forward;—will wash away the pollen, or *farina fœcundans*, and hinder the flowerets from being fecundated;—and will keep the roots of the plants in so wet a state, as to occasion an abortion in the ear.—By heavy rains also, corn is frequently lodged, in which case, unless raised again by the wind, it may never reach maturity, the ears being deprived of air, and the roots kept in too moist a state. The securing the crop must always be attended with much difficulty, when it has been thus lodged. But the injury is less, when the crop has been drilled, which admits of air to nourish the ear, and to dry the stem.

2. *Fogs*, or *Mist.*—The diseases of grain are often occasioned by thick gloomy weather, more especially if it happens, when the corn is at the height of its vegetation. This is particularly the case in regard to wheat, which, though it grows in a great extent of latitude, requires the advantages of a favourable climate, to preserve it in a healthy state, and to bring it to perfection.

3. *Dews.*—Grain, and other plants, are frequently supposed to be injured, by a species of moisture falling upon them, of a clammy and glutinous nature, which checks the perspiration of the plant, hinders the circulation of the nutritious sap in the proper vessels, and binds up so closely, both the straw, and the tender ears of grain in general, and of wheat in particular, as to prevent the future growth of the plant, and the filling of the grains. If there be sunshine next day, the damage is said to be certain, but it does little mischief, if damp or windy weather follows immediately*. What is called the *honey-dew*, (*suffusio mellita*),

* Dorset Report, p. 209.—Dew-drops have frequently been shaken off the ears of grain, by means of ropes, and other contrivances, and if done before the sun rises, *with success.* About Bakewell in Derbyshire, it was

does not proceed, however, from the atmosphere, but is a diseased action, or perspiration of the plants on which it is found*.

4. *Frosts.*—Grain is frequently injured by frosty weather. The lands most liable to frost, in general lie low, are sheltered by plantations, and have a southern rather than a northern aspect; being thence more exposed to the warmth of the sun. The more elevated lands often escape from the coldness of their atmosphere, and their being less liable to damp. Frost also hurts plants soonest, when the air is still, which is more frequently the case in low, than in high situations.

In winter, if the ground is in fine tilth, the surface is full of moisture, and the frost has great influence, elevating the surface of the soil, together with the plant, and separating it from its seminal roots, which sometimes remain stationary in the ground, and at other times come with it. When a thaw takes place after a sharp frost, the wheat plant is observed to turn black, or to die, in consequence of the tube of communication between the seed vessel and the plant being ruptured, and the supply of nourishment consequently cut off. During the continuance of the frost, the plant remains in a torpid state; but heat and moisture succeeding, if the plant can perfect its coronal roots, it may still be productive†. In general, however, wheat, while it continues in a grassy state, recovers from the checks which it receives. But when it makes its principal shoot, previously to its producing its blossom, it grows as much in a few days, as it does at any other period in a month; and and in this state, it must of necessity be so tender, as to be sensible of every change in the atmosphere, consequently it is then in most danger‡.

Sudden transitions also, from heat to cold, during the delicate crisis of the wheat, at the period of blossoming, are highly pernicious; and corn frosted in this state, cannot be

formerly the practice, for two men, walking in the furrows, to lash the dew off the ears of wheat, to prevent the effects of the mildew.—*Derbyshire Report*, vol. ii. p. 123.

* Darwin's Phytologia, p. 35, 325.—Others contend, that the honey-dew, (which is a transparent glairy matter), is deposited by some species of insect. Mischief has often been fancifully ascribed to this cause.

† Communication from the Rev. Robert Hoblyn.—The wire-worm frequently destroys the same tube of communication between the seed vessel and the plant, just below where it is connected with the surface of the earth; but the plant may still revive, if it can produce coronal roots.

‡ Middlesex Report, p. 205.

depended on for seed. Some attribute even the rust, to wheat plants being ruptured by frosty nights, succeeded by hot days*. Wheat with large porous stalks, which absorb a great deal of moisture, is more liable to injury, than where it has a smaller and more solid stem. The damage done by frost, however, depends much on the temperature and brightness of the succeeding day. Should it be cold and gloomy, the injury is less, and if rain should fall, the plants will escape unhurt. But if the morning be warm and bright, the leaves of the plant often become black, and never revive, the effect corresponding to the degree of the returning stimulus†.

5. *Hail.*—In many parts of the Continent, storms of hail do infinite mischief to the crops, and often desolate entire districts. This is particularly the case in autumn, when, from their weight, and the violence with which they fall, hailstones beat down, and shake out, ripened grain‡. It is rarely so injurious in this, as in other countries; but even in England, storms of hail have occasionally been destructive§.

6. *Snow.*—When snow covers the young plant in winter, it is rather favourable than otherwise to its future growth; but when snow falls upon grain, either in the blossom, or in the early stages of its ripening, as is sometimes the case in very elevated situations, and in northern climates, it prevents it from reaching maturity, and if later in the season, occasions its being harvested in bad condition.

7. *Heat.*—It must not be imagined, that the effects *of cold* on grain, are alone to be apprehended, since those from

* Pliny, b. xviii. c. 28, likewise attributes the rust to frost. When frosty nights are succeeded by hot gleams, wheat will be more liable to receive, or less able to expel the malady.—*Bedfordshire Report*, p. 383.

† It is ascertained, that if early pease, or potatoes, in a garden, have been attacked by the frost, any damage may be prevented by watering them before the sun has got up; for it is the warmth of the sun, acting on a frosted plant, that occasions the damage.

‡ In Italy, hail is a formidable enemy to vegetation. In Tuscany, in the spring, and in Lombardy, in summer, it has destroyed, *in one hour*, the most flourishing crops of wheat and rice.—*Professor Symonds' Communication on the Husbandry of Italy*, in the Annals of Agriculture, vol. i. p. 207.

§ In the Buckinghamshire Report, p. 8, there is an account of a hail storm that happened in that county, which did considerable damage; but the effects of those storms on the Continent are quite terrific. One happened near Rome, on the 23d July, 1818, where the hail-stones weighed eighteen ounces. Several persons were dangerously wounded; a number of animals were killed, and the crops, which promised a magnificent harvest, were totally destroyed. See also an account of a dreadful hail storm in Scotland.—*Statistical Account*, vol. iii. p. 70.

excessive heat, are equally pernicious. When exposed to that evil, *the plants suffer from a privation of moisture*, become sickly and feeble, are forced into a premature ripeness, and become light and unproductive. If great heats, which weaken the plants, should happen to be succeeded by heavy rains, the quick succession of two such adverse circumstances, is doubly injurious.

8. *Blights.*—Plants are sometimes injured by atmospherical influence, or by means of *blights*, as they are called.—These sometimes arise from the unequal distribution of the electric fluid, or from lightning, which frequently kills the plants, injures their health, or prevents their filling. The effects may be observed by the blackish spots and patches in fields of wheat, sometimes in a zig-zag direction, where the stalks have little or no grain in the ears.—In the spring season, after a warm and dry wind, there is sometimes a blight of a different sort, arising from an excessive perspiration, which enfeebles the plants, more especially if the wind is easterly, —and it either destroys them, or checks their growth. Against these accidents, all human precautions are in vain.

9. *Calms.*—The necessity of air, for the life and health of plants, cannot be questioned. It is in no small degree, by the motion and circulation of that fluid, that they are supported and brought to perfection. Soon after it ceases to move, the plant makes no further progress, it decays and dries up. Wind promotes the growth of plants, not only by the air being moved about, but by its shaking off the dews, and the moisture from rain, that might otherwise be prejudicial. Indeed, the motion or exercise it gives to the plant itself, is of much use. Hence, high hedges, and large woods and plantations, promote diseases, by preventing the beneficial influence of the air. When orchards are sown with corn, the more open parts bear good crops, but the grain produced in the shade, is of an inferior quality. In hot countries also, the wheat grown in large and open cultivated fields, is less subject to disease, than in an inclosed field of small or moderate dimensions. Open fields, from the same circumstance, generally produce a brighter and heavier sample than inclosed land.

10. *Variable Weather.*—Great wetness, cold, or heat, is injurious to grain, more especially when the weather is variable to any extreme, and when there are sudden transitions from heat to cold, and that followed, perhaps, by a long continuance of wet weather. In that case, it is not to

be wondered at, that crops of grain should be affected, as the tender organs of plants, must be injured, by the alternate expansion by heat, and contraction from cold. Indeed, the diseases to which they are subject, are often owing *to the weakened state of the plant*, and ought not to be ascribed to any one cause, but to the variableness of the season, the weakness taking place some days, and perhaps weeks, before any diseased appearance is discovered in the plant itself.

11. *Insects.*—The injuries which crops sustain, from the attacks of insects, are often very great. The roots are in every season more or less destroyed by grubs* and worms; and in many places, as in the southern parts of England, insects attack the ears of wheat, and occasion considerable damage; the grain become shrivelled, and in some instances, a considerable part of the crop is destroyed. In fact, if these insects, in particular the *ear-worm*, or *tipula tritici*, were not attacked and devoured by a number of enemies, as small birds, &c. the destruction occasioned by them would be immense.

12. *Birds, and Vermin.*—When the crop is ripening, and until it is secured in the stack or barn, it is exposed to the attacks of hosts of enemies, as sparrows, pigeons, crows, game, &c. from whose depredations, much injury is sustained. Nay, after the grain is stacked, or housed, and even deposited in a granary, depredations to a very great extent, are often committed by rats and mice, unless they are guarded against with much care. The following recipe for destroying rats, will be found to be the most effectual hitherto prepared:—Take a quart of oatmeal, two ounces of pounded sugar, four drops of oil of rhodium, four drops of oil of carraway, four drops of oil of aniseed, a quarter of a grain of musk, one ounce of powder of fenegrate; mix these all together, and put some of the mixture on a board in a place where rats resort; let them feed on this for four nights; and, when they appear accustomed to it, take half an ounce of arsenic, finely pounded, and mix it with the other ingredients. In the morning take up what is left.—This mixture is sufficient to destroy three hundred rats; and more than this number have been found killed by it.

* For destroying grubs or slugs, sowing salt with the seed, strewing barley chaff over the surface, so as to entangle and destroy them,—spreading hot lime over the field,—rolling it, or treading it with sheep, have all been recommended.

All these circumstances prove, that the profits of the husbandman are precarious; and that the hazards to which these crops are liable, on which our subsistence depends, are more numerous, than at first view could well be imagined.

Sect. XXII.—*On the Diseases of Wheat.*

The two principal diseases of wheat, are, *Smut*, and *Rust*, or *Mildew*, the nature of both of which, and the means of preventing them, in so far as it has hitherto been accomplished, shall be briefly explained. To discuss the other diseases of grain, would be entering into a field too wide for a publication of a nature so limited and condensed.

The Smut.*

This disease is a species of degeneracy of the grains in the ear, by which the substance that should form flour in the grain, becomes entirely changed into a black powder, similar to a puff ball, or dusty mushroom, (*lycoperdon globosum.*) This disease destroys the value of the seed;—renders the flour of a dark colour, which diminishes its prices;—and some are of opinion, that it possesses noxious qualities. It has likewise a great tendency to spread, and to contaminate all the adjoining grain, and rapidly to widen the mischief. No wonder, therefore, that its ravages should have commanded the attention of husbandmen, in all ages, and in almost every country. It was formerly so common, that in some countries it was not unusual, to see twice or thrice as many smutted ears of corn, as sound ones. Fortunately, the means of preventing it, have long been in the power of every farmer, for any operation that completely frees the seed from smutty powder (the source of the infection), or that destroys it by acrid, corrosive, or poisonous applications, will have the effect of securing a clean crop†; and though some-

* In French, *Le Carie;* in botanical language, *ustilago.* Tull informs us, that brining seed wheat, to prevent smut, was first practised about the year 1660, when a vessel with wheat was sunk near Bristol, and the grain so much injured by salt water, that though it would vegetate, it was considered to be unfit for bread. It was taken out of the vessel at low water, and sown in different parts. It was free from disease at the following harvest, when wheat in general happened to be smutty. This accident led to the practice of brining.

† Sussex Report, p. 85, note.

times crops may escape without preparation, that is no reason, why every rational means should not be adopted, to guard against such an evil.

As a safeguard, it is an excellent practice, when the wheat seed is first put into any liquid, to run it, *very gently*, through a riddle, when not only the smut balls, but the imperfect grains, and the seeds of weeds, will float, and may be skimmed off at pleasure, which is not the case, when the seed is put hastily into the brine or water*.

Numerous are the modes by which smut may be prevented; as, 1. By pure cold water and lime; 2. By boiling water, and lime; 3. By water impregnated with salt; 4. By urine pickle; and, 5. By a variety of other processes, to be briefly enumerated.

1. *Pure cold Water and Lime.*—So important an operation, as the preparation of seed wheat, ought not to be performed in a slovenly manner, if the object be, to secure with certainty, the future crop, from so destructive a disease as smut. It may be effected, however, by pure cold water, provided the seed be washed in several waters, frequently stirred, so as to give the light grains an opportunity of rising, that they may be skimmed off; and repeatedly changed, until it be perfectly clean. It should then be dried by quick-lime, slacked either with sea, or with boiling water†.

2. *Boiling Water and Lime.*—This mixture, when properly applied, is found to be effectual. Sometimes chalk lime, recently burnt, is put into a copper of boiling water, and as soon as the lime is dissolved, the mixture, at this degree of heat, is poured upon the wheat, previously spread upon a stone floor, and the wheat and mixture are immediately well turned together with shovels‡. Sometimes the wheat, put into a common wicker basket, is dipped two or three times, in a mixture of hot water and quick-lime§; and sometimes boiling water and quick-lime, have been successfully used, after the seed has been well washed and skimmed‖.

* Communication from Mr. Blaikie, at Holkham.

† Northamptonshire Report, p. 89; Surrey Report, p. 217; Cornwall Report, p. 60; North Riding Report, p. 112; Annals of Agriculture, vol. xxi. p. 210.

‡ Middlesex Report, p. 207. § Dorset Report, p. 212.

‖ Buckinghamshire Report, p. 179. An experienced agriculturist, has used this pickle for his seed-wheat during the space of 15 years, and with

3. *Salt Water.*—It is a still more effectual practice, to make use of either fresh water, so impregnated with salt, that an egg will float in it, or of sea water, with such a quantity of salt dissolved in it, as to be equally strong, by which its specific gravity will be so increased, that all unsound grains will swim in the pickle. About a bushel of wheat at a time, is put into a sufficient quantity of this pickle, in which, when stirred, all the light or diseased grains will rise to the top, and may be skimmed off. The seed wheat is then separated from the pickle, spread upon the floor, and a sufficient quantity of new slacked lime, to dry the whole, sifted upon it*. If the wheat is to be drilled, after being limed, it should lie a day on the floor, or be kept for that space of time in sacks.

4. *Urine Pickle.*—Some farmers are satisfied, with merely sprinkling a heap of seed with stale urine, and then drying it with lime; and there can be no doubt, that by this mode of pickling, if carefully done, the object may be effectually answered. Others prefer steeping the seed in pure water, (skimming off any light grains that may float on the surface), and then applying the urine to the seed. The grain thus first imbibes a harmless species of moisture, and the more acrid matter, to be afterwards applied, only acts upon its surface, where the source of the evil is deposited. This is attended with some additional trouble, but is an excellent precaution, by which any risk of injury, from the after application of the urine, is prevented, should the grain not be immediately sown, which, however, is desirable. After the wheat has been pickled with urine, and dried with quick-lime, if not immediately used, it ought to be spread as thin as possible, upon a stone floor, to become dry. If it be put close together, and lie in that state for a day, not a grain will vegetate.

5. Various other steeps and practices have been recommended, as, soap-boilers' leys†,—a ley of wood ashes,—

uniform success, though he was twice or thrice under the necessity of using smutty seed. He generally added one gallon of soap-lees to ten of water, and kept the seed in steep, from 15 to 24 hours. But he agrees with the late celebrated Arthur Young in opinion, that steeping for 24 hours is necessary to prevent smut effectually.—*Remark by Edward Burroughs, Esq.*

* East Lothian Report, p. 111.—In Norfolk, wheat, previously moistened with pure water, is candied with lime, slaked by very strong brine. The lime is applied in its hottest state, and smut is thus prevented.—*Marshall's Norfolk*, vol. i. p. 219.

† Derbyshire Report, vol. ii. p. 116.

lime water,—a solution of arsenic*,—powdered wormwood in stale urine,—and kiln-drying the seed, which, though a hazardous, is, when properly executed, a successful mode of preventing smut†.

In every preparation it is necessary, either to kill, or mechanically to force off, the semina of the smut.

Mr. Benedict Prevost, a Swiss naturalist, has recently discovered, that a solution of blue vitriol, (the sulphate of copper), likewise insures so desirable an object. Indeed the practice, when carefully executed, is considered to be *infallible*, for it destroys the vegetative powers of the smut. The process is a simple one. Dissolve three ounces of blue vitriol, in three English gallons of water (wine measure), for every three bushels of grain to be prepared. Let the liquid be put in a vessel capable of holding from sixty to eighty gallons, in such a quantity, that when three or four Winchester bushels of wheat, shall be poured into the prepared liquor, it will rise five or six inches above the corn. The grain should be frequently stirred, and all that swims on the surface carefully removed. After the wheat has remained half an hour in this preparation, it should be taken out of the vessel, and thrown into a basket, that will allow the water, but not the grain, to escape. It should then be immediately washed in rain, or pure water, which prevents any risk of its injuring the grain. The seed ought afterwards to be dried, without applying lime before it is sown. It is proper to observe, that the grain should not be put into the prepared liquor, unless it has been well dressed, *and is thoroughly dry*‡. It may be kept without injury.

* This is strongly objected to, from the hazard attending it, and its destruction of game. A farmer in Essex, who was accustomed to steep his wheat in a solution of arsenic, had his crops exempted from smut, but he was remarkable for bad health.

† At Wooler, in Northumberland, it is said, that passing seed-wheat loosely through mill-stones, so as not to injure the grain, has been found to prevent smut; the seed of the disease, which is commonly lodged in the downy part of the grain, being removed by that operation.—Mr. Prevost has proved, that smut originates from the seeds of a fungus, for he has grown it on moist cloths. See Hints on the Agricultural State of the Netherlands, Appendix, p. 5.—There is a luminous exposition of the chemical nature of the smut in wheat, and a correct analysis, extracted from the works of Fourcroy and Vauquelin, in Mr. Hoblyn's Prize Essay on the Diseases of Wheat, in the Papers of the Bath Society, vol. xiv. p. 88.

‡ The *Prefect* of the Tarn and Garonne, in France, in 1814, publicly recommended it to his department; and in a recent communication from the Academy of Dijon, the sulphate of copper, is strongly recommended. It has been tried with the greatest success in the neighbourhood of Birmingham, of which Mr. Hipkiss has given, in the Farmer's Journal, the most

The following miscellaneous particulars respecting smut, and the means of preventing it, merit attention. 1. The same water should never be used but once in washing wheat; —with brine, on account of its expence and acrid qualities, the same precaution is not required. 2. Liming is not only of service to dry the seed, but by its caustic and antiseptic qualities, it tends to destroy putridity, and animalculæ of every description*. 3. If smutty grain is not threshed, till the June or July succeeding the year it was reaped, the dust, it is said, will become too volatile to attach itself to the grain when threshed, particularly by a mill†; nor is old seed wheat so liable to occasion smut, which, by age, loses the power of reproduction‡. 4. Notwithstanding the violence of threshing-mills, they do not bruise the smut balls so much as the flail§. 5. Great care must be taken, not to thresh clean wheat on a floor where smutty wheat has been threshed, nor to convey the seed, in a sack in which smutty wheat had been formerly put‖. 6. It is contended, that every precaution will be in vain, if the land is manured with dung made from straw where the crop was infected; and thence that the disease may appear, notwithstanding the seed has been carefully steept. But this risk is not great, and the evil can only be partial or local.

The Rust¶, *or Mildew.*

It is now proposed to discuss, 1. The nature;—2. The causes;—and 3. The probable remedies for the rust, or

convincing evidence. In his letters in that paper, published on the 22d October 1818, and 6th November 1820, (signed *Nemo)*, he says, "That the expence of the sulphate is trifling, and its operation is so much more agreeable, than some of the disgusting processes had recourse to for the same purpose, that it furnishes every inducement to make the trial."

* Dorset Report, p. 209. Hoblyn's Essay, p. 89.

† North Wales Report, p. 187.

‡ Mr. John Finch of Billericay, who farmed in the Hundreds of Essex, constantly used OLD *wheat*, and never had any smutty wheat. He was originally led to the practice from parsimony. He had remarkable good crops.

§ Berwickshire Report, p. 231; Bedfordshire Report, p.354; Northamptonshire Report, p. 87.

‖ Derbyshire Report, vol. ii. p. 117.

¶ Rust is the proper name, being a literal translation of the French "*La Rouille*," and the Latin *Rubigo*." The disease has at first, a brownish, *rusty* appearance, which afterwards becomes black. By some, the term *rust* is given to a disease which attacks wheat in the shape of a red powder on the leaves and ear. In most cases, it does not greatly affect the produce, or even the quality of the grain. Blight, an accident arising from atmospheric influence, has been already described, p. 409.

mildew (*rubigo*), that source of so much injury to the farmer.

1. *Nature of Rust.*—A distinguished naturalist is of opinion, that this disease is occasioned by the growth of a minute parasitic *fungus* or mushroom, on the leaves, stems, and glumes or chaff of the living plant; and that the roots of the fungus, intercepting the sap intended by nature for the nutriment of the grain, render the corn lean and shrivelled, and in some cases, rob it completely of its flour*. Nor is that all: the straw becomes black and rotten, unfit for fodder, or little better than a *caput mortuum*, possessing neither strength, nor substance.

A respectable clergyman in Devonshire, who has paid great attention to this destructive malady, observes, that the same fungus is generated on many other vegetable substances, besides wheat, such as trees, shrubs, herbs, grasses, &c. varying in colour and size. These, receiving the infection at different seasons of the year, form, as it were, conductors from one to the other, in which *fungi* germinate, effloresce, disseminate, and die, during the revolutions of the seasons†. The *fungus*, having arrived at maturity in the spring, on a few shrubs, bushes, or plants, its seeds are taken up by the next humid atmosphere, (hence the erroneous idea, that the rust or mildew is caused by the fog alone), wafted into the adjoining fields, and the nearest wheat is sure to suffer principally from it. In damp weather also, its seed is more immediately received into the leaves of trees and shrubs, or into their barks and fruits, or the stems of plants, through the medium of those valves or mouths, with which nature has supplied them, for the admission of moisture.

Indeed, whoever examines mildewed plants, with a microscope of sufficient power, will admit, that the spots on the stalks, consist of bunches of small *fungi*, which have their roots inserted in the sap vessels, by means of which,

* Sir Joseph Banks's Account of the Cause of the Mildew in Corn. Communications to the Board of Agriculture, vol. iv. p. 399. See also the Translation of M. Desmazieres's Paper on the Diseases of Wheat, annexed to "Hints on the Agricultural State of the Netherlands," p. 22. The celebrated Tessier was the first naturalist, who directed his particular attention to this subject, in his work intitled, "Traité des Maladies des Grains."

† See the valuable communication on the Mildew, by the Rev. Thomas Clack, Rector of Milton Damarell, in Devonshire. Devon Report, p. 438. The intelligent author, there traces the fungus, in a number of the different trees, shrubs, &c. in which it is found, at the different seasons of the year.

they consume a great part of that nutriment, which nature had intended for the supply of the corn in the ear*.

2. *Causes of Rust.*—Several of the accidents enumerated in the preceding section, may contribute to the production of rust; but the principal causes are, having the land in too rich a state for corn crops;—a too frequent repetition of so exhausting a crop as wheat, more especially on weak soils, when accompanied by much manure;—or the crop meeting with a check in its progress to maturity, and in that weakened state, being exposed to heavy rains, or variable weather.

It has been well observed, that when crops, *intended to ripen their seed*, are objects of culture, there is only wanted, a degree of vigour and luxuriance in the plants, sufficient for that purpose; and if the fertility of the soil be raised to a much higher pitch than is necessary, or consistent with that object, injurious, rather than beneficial consequences, may be the result†. Land may be too rich for corn crops, and it is better to keep it in a *well-balanced condition*, or in a medium state of productiveness, than in too fertile a state‡. The greater quantity of sap and juices, in vegetables growing on highly cultivated lands, it is evident, must necessarily render them more susceptible of the effects of sudden and

* Dorset Report, p. 210.—It is proper to remark, that those parts of the straw, enveloped by the leaves of wheat, are not rusted. This circumstance is unfavourable to the doctrines of those who are of opinion, that rust is neither owing to fungus, or to atmospheric influence, but to a weakness or imbecility, from whatever causes they originate, which induces spontaneous decay. But if that were the case, the whole plant, whether covered or uncovered, would be equally affected by it. If the crop is cut down, as soon as the disease appears, its progress is arrested in the stem, so far as it is separated from the ground; but we are told, that if the plant of wheat is left to ripen its seed, and to shed it spontaneously, without molestation, upon the earth, the stalk, from the effect of old age, is invaded by the rust, and its concomitant fungus, and is brought to decay in the same manner, as by its premature decline. The stubble also is liable to perish in the same way, while any life remains in the roots, after the ear has been separated from them by the sickle. The stem and the ear, after they are separated from the root, are not liable to the operations of the fungus. The portion of the stem, remaining attached to the root, is liable to be attacked, while the living principle remains in the root, but not afterwards. It is then attacked by another species of fungus.—These are important points to ascertain.

† Hence the great advantage of having previously a green crop, to absorb the superabundant and injurious richness of the dung.

‡ Communication from Dr. Coventry. It is stated in a letter from Mr. Wm. Scott of Horncastle, (Farmer's Journal, Nov. 20, 1815), "That wet falling on soils *full of manure*, causeth too luxuriant a growth of corn, from whence springs mildew." This doctrine is sanctioned by the authority of Parmentier, who ascribes the rust, "A l'abondance d'un suc nourricier, resultant d'une vegetation trop vigoureux, plutôt qu'aux brouillards, qui n'y ont aucuns part directe. Traité sur la culture des grains."—Vol. i. p. 242.

extreme changes, and consequently more liable to disease. Besides, as mushrooms are produced on beds of dung, great quantities of manure, must promote the growth of fungi, or parasitical plants, on the crops of wheat, if they are once infected. The wheat produced on the site of a dunghill, is always rusted, even in the most favourable seasons; and if the whole field is a species of dunghill, how can it escape* ? The whole fungus tribe are seldom seen to grow, but from superfluous vegetable matter, as rotten wood, thatch, decayed hay, or some light rich substance, aided by a certain degree of heat and moisture; and there is no substance more analogous to such a production, the offspring of corruption, as dung. This may be regarded at least, as a proximate, or predisposing cause. If the seeds of the *fungi*, float in the atmosphere, they may more easily find a *nidus*, on too succulent and lusty growing plants, the substance of which is in a tender state, and the pores more dilated, whereas a compact soil produces *hard* straw†.

A too frequent repetition of crops of wheat, more especially when accompanied by great quantities of manure, to force a crop, or raised on soils unsuitable to the growth of that crop, will often have the same effect. The rust was but little known in the western, or the northern parts of England, or the southern counties of Scotland, until of late years, when every exertion has been made, to increase the quantity of that grain. Even clay lands, so congenial to wheat, have been injured by such severe cropping; but on weaker soils, as sandy and calcareous loams, the plant has suffered, in respect both of quantity and quality.

It is well known, that loose and open soils, such as turnip lands in general, are the most apt to be rusted; and the reason is, that the roots in them, are the largest and the longest, and generally in search of moisture, run the deepest into the soil. The stems are thence luxuriant, large and porous. The roots being long and straggling, often get into a noxious stratum below, or into one not productive of nourishment. When that is the case, the plant, formerly luxuriant, meets with a sudden check, (for it is only from the extreme points of the roots, that the plant derives its nourishment by absorption); and this sudden check,

* Communication from John Middleton, Esq.

† It is remarked by Mr. Holdich, that the disease is generally in proportion to the broadness of the leaf; that it first takes place upon the upper leaf or *spatha*, out of which the ear issues; when this is narrow, small, and early withered, there is little danger from rust.

predisposes it to disease. If then the month of July is accompanied by warmth and moisture, or even the beginning of August, the plants of wheat, in their weakened state, will be attacked by those *fungi*, to the propagation of which, that description of weather is so favourable, more especially in places where a free circulation of air is wanting.

In proof of these doctrines, it may be observed, that in loose and open soils, *treading the land thoroughly*, after it is sown, is an effectual preventive of the mildew; the roots being thus hindered from becoming loose and straggling, or getting into poor or noxious strata, whence no nourishment can be derived.

3. *Remedies against Rust.*—Among the remedies likely to diminish the effects of this fatal malady, the following have been particularly recommended*: 1. Cultivating hardy sorts of wheat; 2. Early sowing; 3. Raising early varieties; 4. Thick sowing; 5. Changes of seed; 6. Consolidating the soil after sowing; 7. Using saline manures; 8. Improving the course of crops; 9. Extirpating all plants that are receptacles of rust; and, 10. Protecting the ears and roots of wheat, by rye, tares, and other crops.

1. In a plant of which there are such a number of varieties, as in the case of wheat, it is evident, that there may be some, distinguished by peculiar properties, and consequently less liable to disease†. It is said that the red wheats‡ are hardier than the white, and that the thin, or smooth-chaffed, are less apt to be rusted, than the thick-chaffed sorts. A variety of red wheat, called, *creeping-wheat*, is much cultivated, on that account, in Yorkshire, and on the borders of England and Scotland§; and in Worcestershire, the farmers are partial, on account of its hardiness, to a

* Mr. Benedict Prevost, and other ingenious naturalists, are of opinion, that the rust and the smut are intestine parasitical plants, what the botanists call *uredos* and *puccinias*, and that both might be prevented by the same means, namely, solutions of copper; but as the seeds by which rust is supposed to be produced, are much smaller than those whence smut originates, it demands more minute attention to prevent that disease. Though such solutions, however, have been effectual in regard to smut, it has not hitherto proved equally successful in preventing rust, excepting in once instance mentioned by Mr. Hipkiss of Birmingham. See p. 415.

† Spring wheat is said to be not so liable to be rusted, as other wheat, in Dorsetshire, (Report, p. 213); and in South Wales, (Report, vol. i. p. 399); but equally so in Derbyshire, (Report, vol. ii. p. 119); and in other districts.

‡ Near Exeter, they have lately got a red foreign wheat, which, it is said, is not liable to be rusted.

§ General Report of Scotland, vol. i. p. 447.

species of cone wheat, originally from Courland, which is not so apt to be injured in bad weather*.

2. Sowing wheat early, is a preventive that has been long recommended, with a view of having the ear filled, before the season is likely to be injurious†. In confirmation of that doctrine, it is remarked, that in the county of Somerset, the crops were formerly reaped much earlier than at present, the wheat harvest being generally over in the month of July), and that *the rust or mildew was then unknown*‡. A farmer in Essex, who was accustomed to sow his wheat after beans, had his crops constantly rusted, but was no longer troubled with that disease, *when he sowed early*, either on clover leys, or after a fallow. In Bedfordshire, it is remarked, that wheat which *mays*, or turns yellow in that month, (which is, in general, the consequence of being sown early), never mildews§. It is no advantage, however, to have the wheat too forward in spring, and the sowing should not, on that account, be commenced earlier, than the beginning of September, even on fallows. A distinction ought likewise to be made, between cold, wet, and heavy soils, and the light, dry and porous ones. It is well known, that the latter, though even a month posterior, will be as soon, if not earlier, ready for the sickle.

3. As sowing early, is attended with some disadvantages, (the nourishment in the soil being exhausted *by the stalk*,

* Mr. Holdich reports a very interesting experiment with a variety of wheats, to ascertain which were the most liable to mildew. It was tried at Thorney Fen, (anno 1819), on lands subject to mildew. The seed was dibbled in, in equal quantities, side by side, in small squares in the middle of a wheat field. The result was as follows:

Hungary white, or chitty wheat, short strawed red. These were nearly free from mildew, and were superior in the order in which they are placed.

Square-eared white, velvet white, or egg-shell, were pretty good, but diseased.

Old red lammas, (awned and smooth), Sussex thicket hedge-row. These were much worse mildewed; they are all red wheats.

Talavera-Cape wheat. These were almost good for nothing; not merely with the mildew, but partly owing to the May frost.

† Worlidge's Systema Agricultura, vol. i. folio, p. 210. Printed an. 1681. On the advantage of early sowing, see Oxfordshire Report, p. 151, 152; Northamptonshire Report, p. 86; Berks Report, p. 200; Dorset Report, p. 209, 210, &c. By early sowing, the autumnal rains may be avoided, which put the plant in a succulent or plethoric state, and consequently liable to infection. In dry weather, the straw is of a firmer texture, and afford no admission to the seeds of the fungus that may be slightly attached to them, *if the disease be thus propagated.*—Bedfordshire Report, p. 383. That, however, is much doubted.

‡ Communications to the Board of Agriculture, vol. v. p. 202.

§ Bedfordshire Report, p. 377.

before the formation *of the seed* commences, the plants becoming winter proud, as it is called, or too forward for the season, and the crop being more apt to be injured by spring frosts); it would be very beneficial, to procure a sort of wheat, either from some foreign country, or raised by selection at home, that would ripen early, without being sown much sooner than at present. Nature produces numerous *varieties of the same species*, belonging to the same genus; and it is incumbent on the attentive and industrious farmer, to avail himself of a circumstance, from which so much advantage might be derived*.

4. It is a maxim in husbandry, "*That thick crops are sometimes mildewed, but that thin ones, generally are so, in a greater or lesser degree*†." This arises from the following circumstances: When the seed is sown thick, the roots, instead of becoming long and straggling, are short and numerous. They are retained in the soil, more especially when the crop is drilled, that has been prepared for their reception, instead of wandering into strata, either poor or noxious. From the number of these roots and stems, that richness, that would be injurious to a few plants, only does justice to a number; for the same quantity of dung that might give twenty stems a disposition to disease, would only yield a proper quantity of food, when it had fifty to nourish. By thick sowing in drills, all the advantages of treading, *in so far as respects rust or mildew*, will be obtained, for the roots of the plants will be short and numerous, and matted together, instead of being long and straggling‡.

It is proper here to allude to a communication of much moment, from which it appears, that in former times, when four bushels of wheat per acre were sown, the mildew was of much rarer occurrence, than since the practice of thin sowing has been adopted§; and there can hardly be a doubt, if the land is in good order; if the crop is sown early; if four bushels of seed are sown under the drilling system;

* In Cornwall, they frequently sow a mixture of red and white, (provincially *dredge-corn*), and the crops are more abundant when sown mixed, than when sown separately. When separate, the produce may not exceed 18 bushels per acre; whereas when the two sorts are mixed, the produce will amount to 24 bushels.

† It may be said, what is thick and what is thin sowing? That must evidently depend upon the fertility of the soil, and the period of the year when the seed is sown.

‡ In regard to the quantity of seed, see Sect. 8, of this Chapter.

§ See Mr. Purt's Letter, annexed to Mr. Blaikie's, printed in the Farmer's Journal, dated Holkham, Oct. 12, 1820.

and if the wheat is preceded by a green crop, so as to exhaust the pernicious qualities of the dung, that the crop of wheat will not be rusted.

It is proper to add on this subject, that it is much more prudent, to rely on the abundance of seed, than on the effects of tillering. When the latter is depended upon, during the time that the process is going on, much time must be lost, in the progress of the plant to maturity. The consequence is, both a later, and a more unequal ripening.

5. As wheat is not an indigenous, but an exotic plant, it might be less liable to disease, if the seed were occasionally changed by importations from foreign countries. The best Flemish farmers, regularly change their seed every two years, and assert, "that by this renewal of seed, all the maladies of grain are prevented." Some purchase their seed from d'Armentiere, near Lisle, in French Flanders, while others recommend wheat grown in the *Polders*, (a species of salt marsh) in Holland, by means of which, they maintain, that the rust is avoided*.

It is likewise stated, on the respectable authority of an eminent naturalist, (T. A. Knight, Esq.) that by crossing different varieties of wheat, a new sort may be produced, which will completely escape being rusted, though the crops in the neighbourhood, and in almost every district in the kingdom, may suffer from it in the same year†. These circumstances tend to prove, that the rust does not depend solely on atmospheric influence, otherwise it could not be prevented by changes of seed, or by the crossing of different varieties.

6. The advantages of treading light soils, have been already explained‡. It may be proper, however, to state, the following facts, in support of the doctrine that treading will prevent the rust.—In 1804, a farmer sowed 25 acres of a pea-stubble with wheat. After the usual operations of

* That eminent farmer, Robert Barclay, Esq. of Ury, in Scotland, brought his wheat seed from England every two years; and sowed only what was produced from English wheat the preceding year.

† In Italy, they recommend *thin* sowing, alleging, that as the infection may go from ear to ear, it is less apt to spread, when the ears are not in contact. But this seems to be erroneous doctrine.

‡ A farmer has gone so far as to assert, that if the land, *be the soil what it may*, was trodden by a troop of horse, or a drove of cattle, after being sown with wheat, there would be scarcely such a thing as the rust known. But it is obvious, that treading in this way would do no good *to clay land*, but on the contrary, might much injure the crop. Light soils are more liable to produce mildewed wheat, because the plants grow too fast in spring, and have long and straggling roots.

ploughing, scarifying, manuring, sowing and harrowing, it was trodden with sheep, to the consistency of a highway. The produce was 32 bushels per acre. For the sake of comparison, a part of the field was left in a light state, untrodden, and it was rusted. The same farmer had 14 acres of wheat planted with potatoes. The potatoe tops were pulled up, and the wheat sown on the surface. The potatoes were then forked and dug up, and the wheat trodden by the women and children in picking up the potatoes. The crop was free from rust, and of excellent quality. It has often been remarked, that when a field has been destroyed with rust, the head-lands, which the horses have trodden much in turning, have generally escaped*.

7. The advantage of using saline manures as a remedy against the rust, (a late discovery), is an important circumstance. Its success seems to be proved, by the successful practice of several farmers in Cornwall, who have been in the habit of sowing, about a fortnight before the turnips, the refuse salt of the pilchard fishery, as a manure for that crop, in the proportion of 31½ bushels of salt, (56 lbs. each), per statute acre. They all agree, that they have never had any rust on their wheat, where this practice was adopted, though before, they were greatly affected by it†. The expence would be inconsiderable, for, if it were free from duty, salt might be had from Liverpool, for less than 1*s.* per bushel, and rock salt would be still cheaper. The uses of salt in animal life, prove how beneficial it would be to vegetables. In animals, it is found to promote perspiration, *and to prevent corruption in the juices*‡; and consequently it is the most likely means of checking the propagation of fungi, and preventing that rottenness and corruption, to which wheat is liable when it becomes rusted. This doctrine is strongly supported by the following facts: 1. Rust is rarely experienced in the immediate vicinity of the sea, unless when the ground is greatly over-manured§; 2. When sea-ooze is employed as a manure, impregnated as it is with saline particles, the crop generally escapes that disease; and, 3. That rust is little known in Flanders, where Dutch ashes, *full of salts*, are in use.

* It would not be difficult to invent a machine that would compress the land, if that operation would effectually prevent the rust.

† Particularly Mr. Henry Sickler, whose practice was communicated in a letter, to a respectable Member of Parliament, Davies Gilbert, Esq.—See also the evidence of Dr. Paris, before the Salt Committee of 1818, p. 30.

‡ Code of Health, 4th Edition, p. 178.

§ Essex Report, vol. i. p. 301; Dorset Report, p. 209.

8. As land in too rich a state is apt to produce rust, it is found to be an effectual remedy, if, previous to a crop of wheat, the dung be applied to a smothering crop, as tares, hemp, or cole-seed, on strong lands, or potatoes on light soils. Indeed wheat after cole-seed, is scarcely ever known to be rusted*. The general culture of that article, and the use of Dutch ashes, impregnated with saline matter as a manure, tend greatly to that exemption from rust, by which wheat in Flanders is distinguished. Potatoes, *when the crop is large*, have sometimes had the same effect. A field was sown with wheat, partly after summer fallow, partly after clover ley, and partly after potatoes; the two former were found rusted; whereas the part where the potatoes had been sown, produced grain, plump and equal, and only deficient about one-tenth of the usual quantity. Wheat, after a thin crop of potatoes, is, however, often rusted in this country; but in Flanders, where the wheat is never materially injured by rust, potatoes are considered, in its highest cultivated district, (the Pays de Waes), as the best preparation for that crop. If too much dung occasion the propagation of *fungi*, which there is reason to believe is the case, smothering crops, by exhausting and diminishing the strength of dung, may take away that tendency.

9. Mr. Clack, whose valuable communication on the subject of rust, has been already adverted to, recommends, the cutting down all those plants which retain the *fungi*, in their various stages, even during the severest frosts of winter, and which, on the return of a little mild or humid weather in spring, are thought to contribute to affect, with an astonishing rapidity, the earliest leaves and shoots of those vegetables, which are congenial to their propagation. These fungi flourish with such an extraordinary luxuriance, that in the course of a week or two, they seem to arrive at maturity, and disseminate their baneful effects throughout thousands of acres, on which depend the profit of the husbandman, and a large proportion of the sustenance of the community†.

Among the common plants, the colts-foot, the yellow corn thistle, and the common couch, are said to be so favourable to the growth of these *fungi*, that no field can be free from rust, in which they are to be met with. Every

* General Report of Scotland, vol. ii. p. 530; Dumfries-shire Report, p. 31, and Appendix, No. VI. p. 581.

† Devon Report, p 436.

exertion ought therefore to be made, for their total extirpation.

Some evergreens seem to retain these *fungi*, during the coldest seasons, as the box, when planted in low and damp situations, and above all, the bramble-bush, which ought to be cut down as close as possible, in hedges and coppices, at least once or twice a year. The arbile, or silver poplar, and willows, ought to be kept under, as some of the chief causes of rust in their neighbourhood.

Several trees, also, retain old fungi during winter, on their barks, as the black alder, the common willow, the hazel, the birch, and sometimes oak coppice. The barberry retains this source of mischief, in any fissure or cleft in the bark occasioned by injury, exhibiting numerous black pustules. These should be cut out. The contradictory accounts regarding the effects of the barberry-bush, in occasioning rust, may thus be explained. Where the skin is smooth and entire, the barberry does little or no mischief; where there are fissures in the bark, it proves the source of destruction. Hence, also, when the barberry-bush is small, it does not occasion mildew*.

The practice of cutting the hedges, when a crop of wheat is sown, ought to be universally adopted, as a likely means of lessening the quantity of *fungi*, that would otherwise injure the crop. By this attention to the improvement of his hedges, Mr. Clack's glebe, on which, from time immemorial, the wheat was subject to rust, has been rendered nearly as clean as the fields of his neighbours†.

10. A curious and most important circumstance, connected with the rust in wheat, remains to be stated. In the northern counties of England, where it is the practice to sow what they call *meslin*, (blend corn), or a mixture of rye and wheat, it has been there remarked, that wheat, thus raised,

* Bedfordshire Report, p. 379.—The facts brought forward in the County Reports, Cheshire, p. 135; Cambridge, p. 131, seem to prove the fatal effects of the barberry, in occasioning rust.

† In a recent communication, dated 16th June, 1817, Mr. Clack states, that in the year 1811, he sowed a field of wheat after clover, which was notorious for rust; but the crop produced next year, was the best in the neighbourhood, which he attributes to his continued attention, in cutting out such shrubs, as were congenial to the growth of rust, in the adjoining coppice and hedges; and to the consolidation of the soil, by spreading it with sheep after sowing, for which purpose, a number should be collected, and slowly driven in a compact body, so as to give a simultaneous effect to the land.

*is rarely infected by the rust**. It is singular, that the same circumstance has been observed in Italy. In an account drawn up by the late Professor Symonds, of Cambridge, on the climate of that country, it is recorded as a known, but extraordinary fact, "that wheat, mixed with rye or tares, (for it is a frequent practice there, to sow tares with wheat), *escapes unhurt*†." It would appear, from tares being so useful, that the seed of the fungus, must be taken up *by the root*, and that if the root be protected, it is sufficient. This seems to be countenanced by other circumstances, as, that by treading the ground, and thick sowing crops of wheat, the crop is less liable to be infected by this disease; the access of the seeds of the fungi, to the root, being rendered more difficult. The effect of tares as a preventive, may easily be tried. The double crops sown in Flanders, where the rust is hardly known, is another circumstance strongly favourable to the idea, of the advantage derivable from covering the roots of wheat from infection. Mr. Knight is decidedly of opinion, that the disease is taken up *by the root*, (every experiment to communicate it from infected straw, to others, proving abortive); and indeed, if it were introduced at the ear of the plant, how could it descend, and infect solely the stem? which is the case, unless when the disease is inveterate. Others attribute rust to the influence of the sun upon the roots.—Hence the advantages of having a thick, rather than a thin crop; and hence, it is said, the beneficial effects of mixing rye with wheat, the rough bending head of the rye protecting the earth from the power of the sun. It is also a singular fact, that plants of wheat under trees, escape rust, though the neighbouring crop is infested with it. This may be owing, either to the protection from the violence of the sun, or the moisture which is retained in the soil, by the means of the shade thus procured.

It may be proper to add, that if a field be evidently affected, and the progress of vegetation stopped, the only way to preserve the straw, and the grain, if any has been formed, from being entirely lost, is to cut it down imme-

* East Riding Report, p. 127.—Mr. Tuke, the intelligent author of the North Riding Report, in a letter to the author, dated 7th March, 1818, states, that until the year 1815, rye grown amongst wheat, was generally allowed to be, in that district, a sure preventive of rust or mildew; but that year, rye itself was infected; and there was very little either wheat or meslin that escaped in Yorkshire.

† See Annals of Agriculture, vol. iii. p. 153.

diately, even though the crop should not be ripe. The straw is thus preserved either for food or litter; and it is maintained, that any nourishment in the stem, will pass into, and feed the grain, and makes a greater return than could well be expected*.

By one or other of these means, and the improvements which may be effected, by the observations of ingenious naturalists, and the experience of intelligent farmers, there is every reason to hope, that the diseases of wheat may, in a great measure, be so mitigated in their effects, that they will not in future be felt as a national calamity. For that purpose, however, it is necessary, that the diligent farmer, should seize every opportunity, of improving his knowledge in the diseases of wheat; should note down all the circumstances connected with the subject, as they occur; and should compare his observations with those of others; that whether the causes of rust are general, or local, they may, as much as possible, be obviated†. He may be assured, that it is "*The perfection of good management,*" to discriminate the causes to which the disorders of grain are owing, and to apply the cheapest, and the most effectual remedies.

Sect. XXIII.—*Of Straw.*

The subject of straw, is of greater importance than is commonly imagined; and the value of that article, taken in the aggregate, entitles it to more attention than has hitherto been bestowed upon it. Farmers are apt to consider it as of little or no worth, because it is not usually saleable, and is rarely estimated, separately from the yearly produce of the soil. But though seldom sold (except in the vicinity of towns), it has an intrinsic value, as a fund for manure, and other useful purposes.

* M. De Chateauvieux recommends, cutting the leaves infested with rust as soon as it appears on them, as a means of checking the progress of the malady.—*Traité sur la Culture des Grains*, vol. ii. p. 243.

† Hoblyn's Essay, p. 73. Mr. Hoblyn's system is, that if the plant be kept in a proper state of health, it will never be injured by the attacks of any parasitic enemy; it must have *a predisposition to decay*, before disease can begin its undermining ravages.—In the human species, the same predisposition to various diseases exists, as generally to the small-pox, and partially to the gout; but that general position does not prevent a careful inquiry into the means of preventing and curing each particular disease.

1. *On the Weight of Straw produced by the different Crops.*

It is evident, that the quantity of straw produced per acre, must differ, according to a variety of circumstances; as, 1. The species of grain cultivated: 2. The different kinds of the same grain, for red oats produce less straw than other sorts*; 3. The season, for in a dry season the quantity is less than in a moist; 4. The soil, for in fertile soils, the straw is more abundant than in poor ones; 5. The season when the seed is sown, for spring-sown wheat has less straw than that which is sown in winter; and, 6. The manner in which the straw is cut, for an inch at the root-end of the straw, is heavier than two at the top†.

It is desirable, notwithstanding these diversities, to be enabled to form *some general idea*, of the average produce *in straw*, of each kind of grain; and the average weight of the whole: but owing to the little attention hitherto paid to the subject, and the scantiness of authorities, the weight cannot be ascertained, with the accuracy that could be wished. It is probable, however, that the following estimates are not far from the truth.

Mr. Young stated, that the average produce *in straw*, stubble included, of all the different crops, rejecting those upon the weaker soils, might be calculated at 1 ton 7 cwt. per English acre.

* Red oats, producing perhaps seven quarters per acre, will often yield much less straw than Angus oats, which may produce only five quarters of grain.

† In Middlesex, wheat is cut so close to the ground, as to add 7*s.* per acre to the value of the straw. *Report*, p. 172.—Near London, where the wheat is bagged, the marketable straw, which yields one Winchester bushel of wheat, averages about three truss, of 36lbs. each. The yield of wheat in all England, is supposed to average nearly 24 bushels; which, multiplied by three, produces 72 truss of straw, per English acre. One load of straw in the London market is 36 truss, and that is the produce of half an acre; therefore an acre produces two such loads of marketable straw, and as each load weighs 11 cwt. 2 qrs. 8 lb., the two loads, or one acre of straw, weigh 23 hundred weight of 112lbs. each, and 16 pounds. If to this should be added, for short straw, chaff and stubble, nearly three hundred weight, the result will be 26 hundred weight per acre. Twenty-four bushels of wheat, of 60lbs. each, is equal to 12cwt. 3qrs. 12lbs. per acre, of clean marketable corn. Add the weight of the straw, &c. 26 cwt. to that of the corn, nearly 13cwt., and we have 39 hundred weight as the whole crop. The variations for all England, are from one half to double these amounts, or from one ton to four.—*Communications by John Middleton, Esq.*

Mr. Middleton calculates the produce of the different crops in straw, per acre, as follows:

	Cwt.		*lbs.*
Wheat, - - -	31	or	3472
Beans or Pease, - -	25	—	2810
Oats, - - - -	25	—	2800
Barley, - - - -	20	—	2240
Average nearly	25	or	2828

or about $1\frac{1}{4}$ ton.

Mr. Brown of Markle, has drawn up the following estimate, of the produce of straw, from the different crops usually cultivated in Scotland. The weight calculated in Scotch stones, of 22lbs. avoirdupois each.

	Stones.		*lbs.*
Wheat, - - - -	160	or	3520
Beans and Pease, - - -	130	—	2860
Oats, - - - -	130	—	2860
Barley - - - -	100*	—	2200
Total - -	520	or	11,440
Average - -	130	or	2860

Crops of rye furnish much straw, having, in some cases, yielded two tons per statute acre. But on the whole, about 1 ton 5 cwt. may be stated as the average of the kingdom†.

2. *Of the Value of the different kinds of Straw, and its total Amount.*

The intrinsic value of straw, must vary materially, according to its feeding properties;—the quantity of manure into which it may be converted when used as litter;—its fitness to be employed as thatch;—or its use in manufac-

* Dr. Skene Keith remarks, that though barley has the least weight of straw, it has a considerable proportion of chaff and light corn.

† In Flanders the weight and value of the different sorts of straw per English acre, is estimated as follows:—

Crops.	*Quantity of Straw.*	*Price.*	*Total value.* £	s.	d.
Rye, -	4000lb. -	one-fourth of a penny	4	3	4
Wheat, -	3000lb. -	one-fourth -	3	2	6
Oats, -	3000lb. -	one-eighth -	1	11	3
Barley, -	1500lb. -	one-eighth -	0	15	$7\frac{1}{2}$

tures*;—these being the chief purposes to which it is applicable; but, in general, the price principally depends on its vicinity to large towns, where straw is wanted for litter, which can be re-purchased when converted into dung, and where other manures can also be obtained in its stead.

At Bath, during the winters of 1791 and 1792, wheat straw was so dear, that inn-keepers, from a principle of economy, used their worst hay, instead of straw, as litter. At Oxford, in 1806, straw sold at from 2*l.* 2*s.* to 4*l.* per load†. But this article is commonly dearer in London and its neighbourhood, than in any other part of the kingdom. It is there sold by the load, which consists of 36 trusses, of 36 lbs. each, or 11 cwt. 2 qrs. and 8 lbs. in all. The price was formerly from 25*s.* to 40*s.* per load; it afterwards rose to 3*l.* 12*s.*‡, but in February 1817, had again fallen to 2*l.* Even at that price, it produces above 4*l.* per statute acre.

In the vicinity of Edinburgh, wheat straw has sold for 9*d.* per stone (22 lbs. avoirdupois to the stone), for litter; and calculating the quantity at 160 stone per English acre, the amount is 6*l.*—Oat straw sells nearly at the same price, being reckoned more palatable and nutritious both for cows and horses; and the crops are often so weighty, that it fetches 7*l.* per English acre. In Aberdeenshire, on the other hand, straw is seldom worth more than 2*l.* per acre§.

The value of straw for feeding stock, depends much upon the season when it is consumed. From the beginning of November, to the 1st of March, when black cattle have turnips in abundance, the straw of oats, and likewise of beans and pease, if well harvested, may be safely used *as a substitute for hay*, and may, during that period of the year, be reckoned at from one half to nearly two thirds of its value, whatever the price of hay may be. Nine-pence per stone, however, when hay is 1*s.* 6*d.* per stone, may be con-

* About Dunstable, Luton, and other places in the Chiltern range of chalky hills (where the whitest straw is produced), very important profits are derived, from the sale of the *top joint* of the straw of wheat, to persons who come to the farmers' barns, to draw out, and cut off this part of the straw, tying it into short bundles, which sell, by the pound, to the plaiters.

† Oxford Report, p. 153, 22½ cwt.

‡ Middlesex Report, p. 176, note. 7*l.* 4*s.* per English acre.

§ Communication from Dr. Skene Keith. In any year in which fodder is plentiful, little more than 1*l.* can be got for an acre of straw; but before the introduction of the turnip husbandry, when fodder was scarce, and hay from sown grasses unknown, from 2*l.* to 3*l.* was the price in Aberdeenshire.

sidered its fair value for feeding, during spring; and 6*d.* as the average during the whole year.

In regard to straw used entirely as litter, it is calculated by Mr. Brown of Markle, that 130 stones of straw, the average produce of an acre, will yield four two-horse cart-loads of dung, worth, in East Lothian, 10*s.* per load; that is, at the rate of 3*d.* per stone for the straw, and 1*l.* 12*s.* per English acre. Straw for thatching will be nearly of the same value. On the supposition, therefore, that there are eight millions of acres of cultivated land, annually sown in Great Britain, producing, on an average, 130 stone of straw, one-fourth of which is consumed by feeding, and in that case worth 6*d.* per stone, and three-fourths as litter or thatching, worth only 3*d.* the total value of the straw in the kingdom, may be estimated as follows:

Two millions of acres of straw, at 130 stones per acre, worth 6*d.* per stone, employed in feeding stock,	£6,500,000
Six millions of acres, at 130 stones per acre, worth 3*d.* per stone, for litter or thatching, 1*l.* 12*s.* 6*d.* per acre, - - - - - - - -	9,750,000
Hence eight millions of acres, produce in straw upwards of 2*l.* each; in all, - - - -	£16,250,000

The straw, therefore, annually produced, is of much more consequence, than is commonly considered; more especially when its great importance, as a means of renewing the fertility of the soil, is duly estimated*.

* It is evident, that the MONEY VALUE of the straw, cannot be charged, according to the prices specified in the text, to farmers in general, because most of them are prohibited from selling or disposing of it, and it is essential to them for preserving the fertility of their land. But in a national point of view, the value of the straw is to be included among that of other agricultural productions.—On this subject, Mr. Holdich remarks, that all straw, hay, and vegetables, consumed by cattle, are to be estimated in the cattle only which come to market; and not separately by themselves, which would be to reckon them twice.—Seed-*corn*, and *manure*, also, butter, cheese, bacon, &c. *consumed by farmers' families*, are to be considered, like the soil itself, as necessary adjuncts to cultivation. Implements of husbandry, wear and tear, fences, and drainage, are to be *deducted* in a national view, from *the produce of the soil;* so likewise are all expences in *purchased manure*, excepting when the sale of the straw pays for it. When hay is sold, manure is bought; and the *difference* only, in both cases, ought to be carried to the credit of the account.

3. *Of the various Purposes to which Straw is applicable.*

These may be considered under the following general heads: 1. Feeding stock;—2. Litter;—3. Thatching;—and, 4. Miscellaneous purposes.

1. *Feeding Stock.*—In former times, this was the great object to which straw was applied; almost every stalk, except what was employed in thatching, was devoted to that purpose, and scarcely any left to litter the stalls. The husbandry of the celebrated Bakewell was then much commended, who used no straw for litter; but if he had more than his own cattle could consume, would rather take in those of his neighbours, and give straw and attendance for nothing, than use it for litter. No species of dung was then valued, that had not passed through the body of an animal; and though, by littering, more muck was made, yet the dung produced from straw, when eaten, was considered most profitable. Bakewell, however, became convinced, by experience, that he had adopted an erroneous system, and latterly littered his stock amply. His stock were thus also kept in a superior condition, and his supply of manure was abundant.

But though the plan of feeding stock solely upon straw, cannot be approved of, yet neither is the opposite extreme, that of expending the whole straw, even that of pulse, *in litter*, deserving of approbation. A moderate quantity of straw given to cattle, with turnips, or other succulent food, contributes much to their health. The straw of pulse, when properly harvested, with an adequate proportion of corn, may be given with advantage to working horses, and may save more expensive articles. Without some article of inferior quality, rich food, in too great quantities, would become loathsome and injurious. Dry food is advantageous, by its absorbing the fluids in the stomach, by which that organ has greater power to act upon them; and though such food may not be so necessary, for the sake of the nourishment it affords, an animal may thus be enabled, to take greater quantities of more nutritive aliment. Unless the stomach and bowels be properly distended, digestion is but imperfectly accomplished, and the richest food, will not nourish an animal, with equal success.

The price of hay, indeed, has become so enormous, that it enforces, to a certain degree, the consumption of straw; nor can the soiling system, so advantageous to the farmer,

be carried to the same extent, unless cattle and horses are partly fed with straw and haum during the winter season. Indeed, in the early stages of fattening cattle, straw is as good as hay, for using along with turnips. A greater quantity of clover might, under this system, be employed in summer soiling, which otherwise must have been made into hay, and consumed in winter, instead of straw. But it is absurd to suppose, that the straw should be wholly consumed by cattle, for such food alone, would not fatten them, and their dung would be of little worth.

The properties of the different kinds of straw, for feeding stock, shall next be considered.

Wheat Straw.—On account of its strength, this sort of straw is frequently cut into chaff, and given to horses, with their corn. The chaff is likewise mixed with other food, in particular with potatoes, and given to feeding and working cattle. This straw has confessedly the most heartening quality in it, and is not found, as some have surmised, to be exhausted by ripening its seed; but on the contrary, the plumper the grain, the more solid and nutritious is the straw, the excellence of the one adding to the perfection of the other. Wheat straw is frequently employed for litter, and sometimes for thatching; but in that case the heads of the straw should be threshed separately. In the west of England, they cut off the ears, from the stem, for the purpose of thatching.

Oat Straw.—This straw should be given uncut. It was formerly excellent feeding for stock, when raised on land full of couch, and other natural grasses; but since the introduction of fallow, and horse-hoed crops, very little grass, comparatively, is now found in the straw of any kind of corn. In some counties in England, *oats are given in the straw*, or corn and all, as a species of fodder, which is technically called "*cut meat.*" But that plan is condemned as slovenly and wasteful; for the proportion between straw and corn being so different, it is impossible for a farmer to do justice to his cattle or horses, by a process attended with so much uncertainty. When given in this state, there is a great risk of having the corn unmasticated and totally wasted.

Barley Straw.—When this straw is grown in a southern climate, it is much relished by stock, not being tough, consequently easily eaten; and so sweet, that cattle are particularly fond of it. In Scotland, however, it is considered to be much inferior to oat straw, for its feeding properties. But it is extremely difficult to save it in any tolerable order,

more especially with clover, and its quality is much injured, when, instead of being put in sheaves, it is spread on the ground (the practice in many English counties), for the air and dew, tend to injure every species of fodder*.

Bean Straw.—If well harvested, this straw forms a very hearty and nutritious kind of food, for working horses and cattle, in the winter season; but does not answer so well *with carriage or saddle horses*, being apt to hurt their wind. As bean straw alone is rather dry, a mixture of pease straw, particularly of white pease, which is sweet and nourishing, improves the fodder†.

Pease Straw.—The haum of white pease, if cut green, and dried quickly, in the full vigour of its sap, is fodder of a superior quality, and horses will thrive on it nearly as well as on hay. For sheep, this food is so excellent, that on some farms, where they make a part of the stock, pease are sown wholly on their account‡. The straw of early white pease, applied to sheep, Mr. Young observed, was the most valuable return made by straw. Pease haum, sometimes produces a ton and a half per acre, and if well harvested, will sell, according to the price of hay, at from 4*l.* to 7*l.* 10*s.* per acre, being often of almost equal value to the grain itself.

Tare Haum, or Hay.—Tares have sometimes produced from ten to twelve tons of green food, which, when dried into hay, were found to be one-fourth part of the weight of the fresh-mown tares, or from two and a half to three tons per acre; that is, when they are not suffered to stand for seed, but the whole crop is mown, partly for soiling, and partly for hay, which is of the highest quality. When suffered to stand for seed, the weight of the hay is still less§.

* It would be advisable, when barley and clover are sown and cut together, to bind the sheaves, and to stook the corn for some days, until the bottom of the sheaves are soaked and withered. By this means, the clover will retain its succulency, and the straw will imbibe the nutritious properties of the clover.

† Both bean and pease straw will give some horses colic pains. Half an ounce, or a table spoonful of laudanum, with four ounces of castor-oil, or three table spoonfuls of turpentine, will remove the complaint; to be applied a second time, if the first is not effectual.

‡ The haum of white pease is esteemed very proper for sheep on turnips. It prevents scowering, and in that respect contributes to preserve them in good health. In many districts, it is much used for that purpose. *Communication from John Middleton, Esq.*—If pease straw has not been well harvested, it ought to be kept till the succeeding season after it was cut.

§ When tares are permitted to ripen their seed, the weight of the crop is considerably reduced, but its money value is increased. The clean tares are

For the purpose of making the best hay, the crop should be mown, as soon as the blossoms begin to fall off, or the pods to form. They require a continuance of dry weather, to be cured in perfection; but if well harvested, they are worth from 8*l.* to 12*l.* or even 15*l.* per statute acre*.

The rules respecting the consumption of straw in feeding, may be considered as applicable to, 1. Cattle; 2. Horses; 3. Sheep; and, 4. To some particulars of a general nature.

1. *Cattle.*—Straw, of good quality, may, at the commencement of the fattening process, be given to cattle, as an economical mode of feeding them, accompanied by turnips; but in the more advanced stages of that process, hay is so much superior, that it should, if possible, be supplied. If straw be given for only a month or six weeks in winter, it will be a great saving in so expensive an article as hay. In spring, hay, from its being closely packed, and less exposed to the influence of the atmosphere, retains its nutritive juices much better than straw; hence the former has greatly the advantage over the latter, and is therefore to be preferred. When cattle are fed with distillery offals, straw should be given them twice a day, with the grains or wash; for it has been found, that without straw or hay, cattle would not feed so well, owing to their not being able to chew the cud†.

2. *Horses.*—It is disputed, whether working horses should be fed in winter, with straw or hay, though all parties admit, that during the severe labour of the spring months, hay is essential. But pease and bean straw, certainly make good fodder for horses, early in the season; though, if that kind of straw be injured by rain, white straw must be given. With that food, and two feeds of corn, horses will not only plough three quarters of an English acre per day, but are usually full of health and vigour, when the sowing season commences. In regard to horses that are not worked, it is a good practice, to throw the straw before them in the stall, before it is spread under them, particularly if it be sweet and fresh. They always find something to pick out of it; and it makes a wholesome variety in their diet.

generally from twenty to thirty bushels, but in that state the haum is only from one to two tons per acre.—*Communication from John Middleton, Esq.*

* Tares produce but a light return on poor or sandy soils, unless well prepared for that crop. But on loams, or strong clay, they may be sown with one ploughing after wheat, with every prospect of success. In many cases, cattle have preferred the haum of tares, to hay given them after the seed was threshed out.—*Remark by Edward Burroughs, Esq.*

† Middlesex Report.

3. *Sheep.*—There is no food of which sheep are fonder than pease straw*; and where circumstances are favourable to that crop, pease ought to be cultivated, merely for the straw, from the advantages that would thence be derived by the sheep farmer. Indeed, when it is proved by experience, that this crop can be obtained from lands preparatory to sowing wheat, without any expence, or injury to the soil, no opportunity should be lost, by which such valuable fodder could be obtained†. Tare straw would answer the same purpose. In Flanders, the straw of beans is reckoned excellent for sheep, and to produce superior mutton.

4. *General Rules.*—The value of straw for feeding, depends upon the soil and climate. In regard to soil, straw from fertile land, is much more nutritive than from land of inferior quality. As to climate, it is asserted, that the straw of wheat, barley, and oats, contains more saccharine matter in the southern, than even in the northern provinces of France, and that the superior sweetness of the one over the other, may be ascertained by masticating it‡. In good seasons, therefore, it must be more nutritious in this country, than when they are unfavourable.

Straw keeps much better unthreshed, in a large stack with its corn, than in a barn; but straw, in whatever way it is kept, more especially white straw, loses part of its value as fodder, after the sharp dry breezes of the spring months have set in. It is seldom given to working horses, after the month of March.

Straw given to stock, should be constantly made use of as soon after it is threshed as possible; for if exposed to the influence of the atmosphere, it becomes either musty or too dry; and in that state, cattle neither relish, nor thrive on it so well. If it must be kept a length of time for fodder, it should be bound *in trusses*, in which state it is easier moved, lies in less room, and retains its strength and flavour rather longer, than when loose; or it may be secured, in a stack properly built, trodden down, and covered.

There is certainly much nourishment in the heads of grain in general, and particularly in the awns of barley; but these require, either to be steeped in cold water, or to have

* It is stated in Young's Essex, that sheep are fonder of pease straw than of hay.

† Remark by Edward Burroughs, Esq.—Hogs are likewise very fond of pease straw.

‡ Cours Complet d'Agriculture, par Rozier. Vide *Paille.*

boiling water poured upon them, before they are given to stock. Cow-keepers will give even a higher price for the awns of barley, than for the heads of wheat.

It is an useful practice, to mix a portion of straw, particularly the straw of oats, with the aftermath of grass, or second crop of clover, at the time of stacking it. The straw absorbs the gasses and moisture as they exhale from the hay, by which the straw acquires juices and a flavour, which are agreeable to cattle; the hay which, in other circumstances, would be spoiled, is in this manner cured, and the mixture is excellent food for stock; while the harvesting of the grass, or clover crop, is thereby accelerated.

Some farmers give the best straw to the young stock, and the inferior sort to oxen. Others, however, reverse the practice, on the idea, that the older the cattle, the better food they require. Indeed the best straw, without the addition of turnips, or other sorts of roots, or cabbages, is but miserable food for oxen. The prudent method is, to give the inferior straw, in the beginning of winter, while there is plenty of other nourishing articles to be eaten with it.

In the consumption of straw as fodder, the inferior sorts should be first made use of, and afterwards those of a better kind. It is necessary that stock, when fed on so coarse an article as straw, should have an abundant supply of water at their command*.

It is disputed, where straw is the chief food for cattle, whether it should be given sparingly, or in abundance. By the advocates for the sparing system, it is maintained, that cattle may be satiated with straw, if served with it in too great plenty; and that they do better, when straw is regularly dealt out to them, which is more the case in years of scarcity, than in plentiful seasons, when it is thrown before them in profusion. On the other hand, it is contended, that straw is not rich enough to produce satiety, though, when cattle are tied up, it may be a good plan to give them but little at a time, as any change must be acceptable to them. But cattle in a straw-yard, require fodder in profusion, that they may pick out the best, and leave what they do not relish, for litter. More straw should be given, when the weather is wet, and less when it is dry; and care should be taken, to proportion the quantity of straw given, to the

* It is found by experience, that store stock do very well upon straw, till some time after Candlemas, but when the days get longer, and drying winds come on, they should have either succulent food, in small quantities, or a little hay, though of inferior quality.

number of cattle in the yard, in order that the dung may be properly prepared.

The straw of some varieties of wheat, has a pith resembling rushes. It has not yet been ascertained, whether the straw of those kinds of wheat, be in any respect more valuable, than that of the common sorts; but there seems little doubt, that the straw of autumnal-sown wheat, is more harsh, and less agreeable to cattle, than the straw of wheat sown in the spring*.

It is remarked, that the straw of corn is weaker, in countries where the vegetation is rapid, as in Scotland, than in the southern counties of England, where the growth is slower and more regular; and that the straw of barley, sown in the month of March, or beginning of April, grows shorter between the joints, and is much stiffer than the straw of the same crop, sown in the latter end of April, or the beginning of May, which latter crops, in wet seasons, generally fall down, while the former stand. This is a circumstance which is favourable to the practice of early sowing, in northern climates.

The ancients were accustomed to prepare their straw for feeding stock, by keeping it for a considerable time, sprinkled with brine;—it was then dried, rolled up in bundles, and given to oxen instead of hay†. The addition of brine, or salt, was certainly an excellent plan, and by a similar practice, the straw consumed in this country, might be greatly improved.

2. *Litter.*—The use of straw, for littering or bedding stock, answers two purposes: 1. It keeps the animals warm and dry, and enables them to repose in comfort; and, 2. By the same means, straw is mixed with the dung and urine of cattle, horses, &c. and converted into a rich manure.

All the various sorts of straw answer the purposes of litter. Some farmers prefer the straw of rye, others that of wheat, which absorbs a great quantity of urine and moisture. The straw of pease and beans, when well broken by threshing, makes soft bedding; but, if well harvested, should be applied to feeding stock. Cattle, when soiled on clover, and other articles, or fed on turnips, are kept in a state of greater comfort when they have a sufficiency of litter.

In the London markets, straw for litter is drawn straight

* Middlesex Report, p. 220.

† Dickson's Husbandry of the Ancients, vol. ii. p. 409.

in handsome trusses; and if threshed in mills, is less saleable, on account of its being more bruised, less sightly in the truss, and less durable in use, an object of some importance, where straw is so dear; at the same time, it is probable, that the advantage of a softer bed for the horses, would more than compensate for the additional expence*. It is singular, that the ancients were accustomed to break straw upon stones, for the purpose of rendering it more easily mixed with dung, sooner dissolved, and better adapted for litter†; an operation which is now so effectually done by means of the threshing-mill.

By some, littering stock with straw, has been considered to be unnecessary; others contend, that all the straw of a farm ought to be exclusively appropriated to that purpose, and none of it applied to feeding stock: the truth seems to lie between these extremes.

In Arabia, where the finest horses in the world are kept, no straw is used as litter. In Sweden, and in Russia, instances are quoted, of horses lying on boards, and of cattle standing and lying on a framing of wood-work, without any straw, or substitute for it, as bedding‡. Such plans, however, will not answer for horses, if exposed to severe labour, as, in that case, they require rest, in the most advantageous manner in which it can be given them.

It may likewise be observed, that the principal advantage of littering, with a view to manure, arises from the straw absorbing the urine, for which purpose it is certainly well calculated. But wherever straw is scarce or dear, peat earth, or fine mould, might be advantageously employed for the mere absorption of urine. Other substitutes also might be used for litter, as fern, shellings of oats§, or small shell sand, all of which have been found to answer.

Straw, however, is the fittest article for this purpose, for, by fermentation, it is reduced into a gaseous state, and by moisture into a fluid state, and in either case, its whole substance is applicable as food for plants. The more of that article, therefore, that can be converted into manure, consistently with the other objects which require the farmer's attention, so much the more will his interest be promoted.

Mr. Young was of opinion, that it was impossible to raise

* Middlesex Report, p. 175.
† Dickson's Husbandry of the Ancients, vol. ii. p. 408.
‡ Middlesex Report, 328.
§ Derbyshire Report, vol. ii. p. 186; and vol. iii. p. 23.

sufficient quantities of manure, more especially where soiling was practised, if any straw were eaten; and the number of the best farmers in Norfolk maintain, that all straw should be used as litter, and trodden into dung, by animals feeding *on much better food*, as turnips, hay, or oil-cake. The principle is a good one, but it can never be generally carried into effect. All farms, as now cultivated, do not produce turnips, which is the best article to use for rotting straw, from the immense quantity of urine it produces; though there are many, in which that crop is now unknown, where a greater or lesser quantity of that valuable root, might be raised. In regard to hay, or oil-cake, these articles are too expensive, and often too scarce, to make the use of them general; and besides, such *dry food*, furnishes little moisture to the dunghill, without which it cannot be so effectually converted into manure.

It appears from the statements of several eminent farmers, that one ton of straw, if properly manufactured, that is, augmented in weight, by the dung and urine of the stock maintained upon the farm, will produce nearly four tons of manure*; and as an English acre of grain, yields more than a ton of straw, hence, on a farm where 300 acres are sown yearly, 100 of them may be manured from its own produce, at the rate of 12 tons per English acre, without the aid of extraneous substances, provided the four-course rotation of, 1. Turnips; 2. Wheat, or Barley; 3. Clover; and, 4. Wheat, or Oats, be adopted. Where the clover is pastured the second year, (which is an excellent system), even less manure will be required than the quantity above-mentioned, while the produce of straw, will annually become more abundant, during the remainder of the course.

As 12 tons of dung per English acre, are necessary in general cases, which would require all the straw produced on the farm, according to its average produce, means ought to be devised, without the aid of any extraneous manures, to make up the deficiency, where a part of the straw is applied to the feeding of stock. The greatest care ought, therefore, to be taken, that the crop be cut as low as possible; while by the aid of mould or peat earth, much urine may be absorbed, that would otherwise be lost. The making

* This is according to the practice of the farmers, in the Lothians. In some districts of England, they maintain, that a ton of straw, when converted into dung, would be reduced to half a ton in weight. But it is evident, that straw mixed with the dung, and saturated with the urine of cattle, must be much heavier than in its dry state.

of composts, likewise, ought not to be neglected, and where this system is practised, stock are maintained with economy, and the soil kept in a fertile state, in a great degree, from its own resources.

3. *Thatching.*—For many ages straw was the common material for roofing farm-buildings and cottages, and was formerly made use of even in towns; but the risk of fire, (to which whole villages have fallen a sacrifice from a single spark); the loss sustained by vermin, which shelter themselves in the straw;—the expence of additional rates of insurance on thatched buildings, from 1*s.* to even 3*s.* per cent. in cases where they were considered to be doubly hazardous;—the increased difficulties attending making a roof with straw, that was threshed by mills, and in a broken state*;—the practice of covering buildings with slate or tiles;—and the greater demand for manure, in consequence of the improved state of agriculture, have all contributed, to diminish the quantity of straw used in thatching. This is a fortunate circumstance for agriculture, as little straw can be spared from litter, even for feeding stock, and still less for the covering of houses. On this subject, Mr. Young very justly observed, that thatched roofs lessened the quantity of dung on a farm, to such an extent, that they ought to be universally prohibited. Fen reeds, and in mountainous districts, heath, may be used, when slates or tiles cannot be had on reasonable terms.

In the more northern districts of Scotland, straw is mixed with clay, and thus a plastered roof is made, which consumes but little straw, and is not liable to take fire. But it is heavy, and requires much, strong rafters, &c. on which more durable materials might be placed. Walls of clay, mixed with straw, are not unusual in several districts of England† and Scotland, for gardens, cottages, and even farm-houses.

4. *Miscellaneous uses of Straw.*—There are few articles, which are applied to a greater variety of purposes than straw. Besides the uses above-mentioned, it is employed for cover-

* In the county of Somerset, wheat is seldom threshed with the straw, but the ears are cut off, and the straws, which are bound in sheaves, tied very tight, are used for thatching.—*Somerset Report*, p. 97, 98.

† Derbyshire Report, vol. ii. p. 14. Mr. Farey remarks, that this practice is found to stretch through England, along the course of the blue lias clay, as the same is depicted in Mr. William Smith's large map of the strata. Several other local practices, modes of culture, and products of the soil, depend upon the nature of the mineral strata beneath the soil.

ing hay and corn stacks;—twisted into ropes, for draining;—mixed with sea-weed in a compost;—burnt for the purpose of obtaining pot-ash;—manufactured into paper;—used in bottoming of chairs,—stuffing collars for working-horses,—and beds for the lower orders;—packing glass, china, and earthenware;—and the straw of grain, and of wheat in particular, in the manufacture of hats, bonnets, trinkets, and various ornaments, by which numbers, who might otherwise find it difficult to subsist, are furnished with the means of employment.

Sect. XXIV.—*Of Stubbles.*

It is not unusual, in some parts of England, when the grain is reaped by the sickle, to cut it knee-high. This probably originated from a wish to save barn-room; and to get the corn more expeditiously carted and stacked, and more easily threshed. But the plan of high-cutting deserves reprobation. By it much grain is lost, for a stubble of 12 or 18 inches, and still more, of two feet, can never be a clean one. By this plan, also, the expence both of the sickle and of the scythe is incurred. Many consider the part nearest the root, to be the most nourishing of the straw, but at any rate, the culling and picking the best part, may be safely left to the instinct of the cattle to whom it is presented. Stubble left in the field, retards much the operation of ploughing, more especially when the plough is turned; and as it is often neglected, and left standing, until its whole substance has been materially injured, by the variable weather to which it is exposed, it may be accounted of little value to the farmer; while, under a different management, if cut with the crop, it would have proved a source of much profit.

Wherever agriculture, therefore, is practised on improved principles, crops of grain are cut so close to the ground, as to leave no stubble that can be mown, or employed to any particular use. It may be proper, however, to state, to what purposes stubble is applied, when left on the ground.

By some farmers it is mown, and collected, to litter the yards, or bottom the dunghill*, but, too often, after its

* Young's Norfolk, p. 300.—It is calculated that this mode of using stubble, unless there is an absolute want of litter, will never pay the expence; for estimating the quantity of stubble got, at seven, or eight cwt. per

substance is wasted.—It is sometimes burnt on the ground as manure, more especially when the land is foul, as tending to the destruction of weeds*. It is sometimes ploughed in, but often to the injury of the succeeding crops; for the stubble renders some lands too open, so that every fall of rain or snow, fills the soil with moisture, which cannot easily be got rid of.—Stubbles are sometimes formed into walls, for rendering farm-yards warm and comfortable for stock†.—Where stubbles are properly managed, they are mown, and as carefully harvested, as any other part of the produce; being brought home, stacked up, and kept for thatching, either buildings, or the stacks of the succeeding year, or for other purposes‡. But by far the most advantageous mode of applying stubble, when mown and harvested, undoubtedly is, to spread it on the surface of the soil, after the land has been completely prepared for turnips, and then to burn it. This is *an infallible mode* of preventing the ravages of the fly in turnips, for they are either destroyed by the fire and smoke, or driven out of the field.

In Derbyshire, a paring plough is used for wheat and other stubbles, by which the roots of the corn and weeds are cut; the ground is then harrowed and raked, and all the stuff thus collected, is carried home to be spread in the bottom of the fold-yard, and trodden into muck. By this operation, not only is the quantity of dung increased, but the seeds of the weeds are brought to vegetate on the stubble land thus cleared, and are easily got rid of§. In the same county, another practice has of late grown up, that of paring the stubbles, and burning the straw, weeds, and roots, intermixed with some earth, in small heaps in the field. This is done, not only for raising a crop of turnips, but with a view of sowing wheat, sometimes even after oats, and must greatly tend to the impoverishment of the soil‖.

In Kent, there is a practice similar to the above, that of

acre, this weight of straw, of the best quality, could be bought for less money than what it would cost to mow, and carry home the same quantity of stubble. Besides, there is little doubt, that the soil would be thereby deprived, of a portion of manure, and of vegetable matter, by which it would be benefited.—*Remark by Edward Burroughs, Esq.*

* This was an ancient practice. See Virgil's Georgics, i. v. 84; and is mentioned in Scripture, Isaiah, chap. v. ver. 24. Obadiah, v. 18.

† Essex Report, vol. i. p. 325. ‡ Huntingdonshire Report, p. 128.

§ Derbyshire Report, vol. ii. p. 124. ‖ Ditto, vol. ii. p. 131 and 406.

shimming the stubble of beans with a plough, *having a very broad share,* as a preparation for wheat. The weeds and roots cut by this implement, are afterwards harrowed out, and either burnt on the ground, or carried to the compost dunghill. The same cleansing process, is likewise applied to wheat stubbles, as a preparation for pulse and other crops. This operation is very useful for clearing the soil from surface-weeds, especially those of a trailing or creeping growth, and for bringing the seeds of weeds, which lie upon or near the surface, into a state of vegetation, and capable of being destroyed*.

Sect. XXV.—*Of Gleaning.*

The origin of gleaning is of great antiquity. Formerly, when the practice was under proper regulations, it was attended with profit to the industrious poor, without occasioning any particular injury to the occupier. Each farmer, in ancient times, had his particular set of gleaning retainers, who assisted him in the labours of the harvest, and they were indulged with the perquisite of gleaning, after the corn had been gathered. This tended to excite, and to preserve, a mutual attachment between the two classes†.

But this privilege came to be abused. Persons who had given no assistance to the farmer, nay, who resided in other parishes, presumed to glean, not only *among* the sheaves, but too often *from* them, conducting themselves in so disorderly a manner, as to occasion perpetual disputes. The mischief which this gave rise to, was often great, particularly in the common-field system, where the loss incurred has been calculated as high as 30 per cent‡. To avoid such depredations, the wheat crop was often cut too late, and carried home too quickly, because the farmer dared not trust it in the field, while the poor were perpetually among the sheaves. In several districts it is still the case. The courts of law have decided against any *right* to gleaning being vested in the poor; but as the practice, under due regulations, tends to promote a friendly intercourse, and kindly connexion, between the upper, and the lower orders of society, it ought not to be given up.

* Marshall's Southern Districts, vol. i. p. 61, 78.
† South Wales Report, vol. i. p. 428. ‡ Ditto, p. 341.

II.

On Rotations of Crops best adapted for different Soils and Situations.

Notwithstanding the multitude of books on agriculture, there is scarcely an author, who, prior to the middle of the last century, seems to have formed any just ideas, either of the importance of judicious rotations, or the principles on which they ought to be regulated. All courses of crops, appeared to them alike, and neither to merit praise nor censure*. Happily the case is totally altered, and this most essential branch of husbandry, is now grounded on principles, as distinct and certain, as those which form the basis of any other science, or direct the practice of any other art†.

It is not without much anxiety respecting the execution of the task, that so essential a branch of the present inquiry is undertaken. It is considered, as the most prominent feature in good farming;—as the most important particular that has been treated of by modern writers of husbandry, and the article respecting which, they have thrown the greatest light;—as capable of furnishing a considerable increase to the produce of the land:—as peculiarly constituting what may be called, *the soul* or essence of husbandry;—in short, as the true ground-work of general improvement;—and, if well understood, as the most likely means, of promoting the cause of agriculture, and the interests of the country. It cannot indeed be represented in too important a light, nor too minutely examined, its object being to ascertain, "*that mode of management, which is the most likely, for a series of years, to yield the greatest quantity of useful produce, at the smallest comparative expence and risk, from any given extent of land.*"

Here it is proper to give, 1. A general view of the principles, which ought to regulate the rotation of crops in every country; and, 2. A list of the crops usually raised on the different soils of Great Britain.

1. The propriety of adopting any particular system of

* Young's Calendar, p. 503; Derbyshire Report, vol. ii. p. 307, note.
† Coventry's Discourses, p. 91, note.

cropping, will be considerably influenced by the following circumstances: *The Climate*, whether it be wet or dry, warm or cold; and the *situation*, whether high or low. Wet climates, and high situations, for instance, are rather favourable to the growth of oats; dry climates, and low situations, to that of barley.—*The Soil:* for sand, gravel, clay, chalk, peat, alluvial soils, and loam, have various crops calculated for each respectively; and *the subsoil*, on the quality of which, the crops to be raised must greatly depend: *The means of improvement by extra manure*, (as lime, marl, sea-weed, town-dung, &c.), at reasonable rates.—*The state and condition of the soil*, whether it be old cultivated land, or recently improved;—whether it be land that has been cropped judiciously, or under an exhausting system of management;—whether it be in good heart, or the reverse;—whether it be foul, or clean; and lastly, the situation of the farm in regard *to markets*, whether they are near, or at a considerable distance; and whether they are adapted to the sale of some articles of produce more than others. For instance, a field of potatoes might be worth 25*l.* per acre near a town, which would not fetch from 5*l.* to 10*l.* in a remote part of the country.

2. It is of the greatest importance to determine, for what crops the soil and climate of any particular district are best calculated; and what objects may be obtained by their cultivation. In Great Britain, wheat is, with the exception of potatoes, the principal *field crop;* whereas, in Flanders, it is considered as only the fifth in point of value*, and it is often raised, merely as a means of procuring manure, for the more lucrative productions of flax or hemp. That these crops should have been prohibited in former times, when husbandry was imperfectly understood, is not to be wondered at; but, that the same prohibition should be still continued, when the experience of Flanders proves, beyond the possibility of doubt, that flax and hemp may be cultivated once in every five or six years, without diminishing the fertility of the soil; and, when the farmer can hardly pay his rent, from the burden of rates and taxes, to which he is subjected, and requires every possible encouragement, can hardly be rationally accounted for.—Every crop should now be

* Vandersıraeten's Improved Agriculture, p. 36. The more valuable crops are, 1. Flax; 2. Hemp; 3. Cole-seed, and 4. Potatoes. Rape for seed is much grown. Besides other advantages, the farmers thus supply themselves with oil for their lamps, and have their light at a trifling expence.

raised, *that will pay best*, at least on the estates of those landlords, who wish to have their lands occupied by thriving tenants. The employment which might be given to the poor, by the cultivation of flax, and the advantage of being rendered independent of foreign nations for naval stores, by the raising of hemp, are separate considerations.

The crops usually raised on the different soils in Great Britain, at present, are as follow:

Crops cultivated on the different Soils in Great Britain:

1. *Sand.*	2. *Gravel.*	3. *Clay.*
Turnips,	Pease,	Beans,
Potatoes,	Tares,	Wheat,
Carrots,	Rye,	Oats,
Mangel Wurzel,	Barley,	Tares,
Barley,	(and on good gravels)	Cabbages*.
Rye,	Wheat,	
Buck-wheat,	Oats.	
Tares, and oats in wet climates.		

Stiff ground!

4. *Chalk.*		7. *Loam.*
Barley,	Turnips,	Turnips,
Pease,	Rape,	Potatoes,
Wheat,	Rye,	Carrots,
Turnips,	Oats.	Mangel Wurzel,
Rape.		Barley,
5. *Peat.*	6. *Alluvial.*	Oats,
Potatoes,	Wheat,	Wheat,
Carrots,	Barley,	Pease,
Tares,	Oats,	Beans,
	Beans.	Tares,
		Hemp and flax.

And on all these soils, clover and other grasses, are, in a greater or less degree, periodically cultivated.

Of the various Sorts of Rotations.

It is not unusual, in treating of this branch of the inquiry, to consider rotations, merely as they are applicable to different soils, for instance, sand, gravel, clay, loam, &c.; but the

* Cabbages succeed best on grounds which are too rich for either turnips or potatoes. They are apt to be injured by frost; and in cold districts, therefore, they ought to be consumed early in the season. Cabbages require so much manure, that they can only be raised with advantage, in places where plenty of dung can easily be obtained. They are rarely, on that account, included, in common rotations.

subject will be better understood, by discussing the different courses of crops, *according to the number of years they respectively require to finish the rotation;* specifying, at the same time, the soils for which they are respectively the best calculated.

In particular cases, some farmers have adopted a course of only *two years crops*, as wheat and beans alternately; or wheat, with crops of potatoes and beans, alternately. On the richest loams, or alluvial soils, reclaimed from the sea, or in the immediate neighbourhood of large towns, where any quantity of manure can be commanded, such a system may be practicable, but in other situations can hardly be adopted. A farmer who had followed this plan for the space of fourteen years near a town, during which he had four crops of potatoes, three of beans, and seven of wheat, found, though the quantity of produce had not diminished, yet that *the quality* of the wheat and beans had degenerated. In Essex, however, on a soil of peculiar excellence, wheat and beans were tried for 36 years in succession, and continued profitable during all that period. There are many farmers in the neighbourhood of London, also, who obtain three crops, every two years, as, 1. Winter tares and turnips; and, 2. Corn, generally wheat; and preserve their land in as clean and rich a state as could be desired. This system is more profitable than any other, and may be found applicable to a larger proportion of the southern districts of England, than is commonly imagined*.

We shall now proceed to consider, what may be properly called a rotation, where the course commences with a cleansing crop.

Three Years' Rotation.—Mr. Mundy, in Derbyshire, has adopted with success the following course: 1. Swedish turnips; 2. Barley; 3. Clover†. But the most productive course of cropping, for a period of three years, commencing with what may be called, under proper management, a cleansing crop, was that adopted by Mr. Greenhill, in Essex: 1. Potatoes; 2. Wheat; 3. Clover. He manured amply for potatoes, of which he raised from eight to ten tons: his wheat usually produced about forty bushels; and he commonly had four tons of hay per acre. This system has been successfully repeated, on the same soil, for thirty

* Remark by John Middleton, Esq.
† Derbyshire Report, vol. ii. p. 103.

years, and has been adopted by a great number of other farmers*.

Four Years' Rotation.—Under this head, the first to be pointed out is, the course known under the name of the Norfolk system, namely, 1. Turnips; 2. Barley; 3. Clover; 4. Wheat. This rotation, however, is not found sufficiently meliorating; for without a plentiful supply of extra manure, and deep ploughing, both the turnip and the clover crop will often fail, unless the land is refreshed by grass, for at least two or three years. To obviate this difficulty, it has been proposed to begin with, 1. Winter tares, followed by turnips, and both fed upon the land by sheep. The soil, thus enriched, will produce, 2. Wheat; 3. Clover; and 4. Barley, or oats, in succession†.

In Scotland, on turnip soils, the following rotation has been found to answer: 1. Turnips; 2. Winter wheat, sown in spring‡, or barley; 3. Clover; and, 4. Oats, introducing partly winter wheat after the turnips, and oats after the clover. This is certainly a productive rotation, and being recommended by farmers, justly accounted among the first in their profession, is entitled to attentive consideration§.

Under careful management, a rotation still more severe, has succeeded; namely, 1. Turnips; 2. Wheat; 3. Grass, (mostly sheep-fed); 4. Four-fifths winter wheat sown in

* Communication from John Middleton, Esq.—In places at a considerable distance from a large market town, 1. Winter tares; 2. Wheat; and 3. Clover, is an advisable mode of cropping, on strong land, in a climate where winter tares can be successfully cultivated.—*Ditto.*

† Communication from John Middleton, Esq.

‡ In regard to winter wheat sown in spring, *after turnips*, an experienced farmer, in East-Lothian, (Mr. Dudgeon of Prora), observes, that it may be safely sown as late as the middle of March, and even later; and that on fine land, it is frequently grown, in preference either to barley or oats, if sheep have eaten the turnips upon the ground, which is the most valuable, and the least expensive method of using the turnip crop. But good land, by this scheme, would be over dunged, were it not for the practice adopted, of stripping out a part of the turnips, to the amount of one-fourth, one-third, or even one-half, (leaving the alternate rows), and carrying those drawn out to be used by cattle. When a certain breadth is thus stripped, the hurdles can be set upon the drills which remain, and the stripping be carried on as the sheep may require more ground.

§ Mr. Rennie of Phantassie, and Mr. Brown of Markle, in East-Lothian.—In the Derbyshire Report, vol. ii. p. 104, the same course is recommended.—By the profits resulting from the adoption of that rotation, an active and intelligent farmer, (John Tennant, Esq. of Girvan Mains, in Ayrshire), has gradually been enabled to stock three different farms; and beginning with a rent of only 50*l. per annum*, he now annually pays 2700*l.* or *fifty-four times* the sum he originally paid when he commenced farming. There can hardly be a stronger argument in favour of that system, where the soil will bear it.

spring, and one-fifth oats. Under this course of crops, the produce of a farm has been improved, both in quality and in quantity, since its commencement to the present time, *and continues to improve.* The additional quantity is, to the amount of not less than four bushels per English acre*.

In the neighbourhood of Dunbar, in Scotland, a course distinguished for its severity, has been tried; namely, 1. Turnips; 2. Drilled wheat; 3. Clover; 4. Drilled wheat. It appears, however, that even in a dry and favourable climate, such as that to be found in the lower part of East-Lothian, and the advantage of great quantities of sea-weed, such a rotation could not long be continued on a light soil. The quantity of dung usually applied, was to the amount of about *twenty* two-horse cart-loads per English acre, to the land intended for turnips, whereas only twelve such cart-loads are commonly given by the majority of farmers. The turnips were always eaten on the ground by sheep. The same quantity of dung, or of sea-weed, was also applied on the grass-land before ploughing. Notwithstanding all these advantages, it was found, that wheat could not be grown with success, on light lands, every other year, for any length of time. After practising it for fourteen years, the result was, that though by the force of manure, abundance of straw could be grown every other year, yet the wheat was light and unproductive. Instead of the second crop of wheat, therefore, oats were preferred†.

The rotation of four crops, adopted near Edinburgh, namely, 1. Potatoes; 2. Wheat; 3. Clover; and, 4. Oats, is a very productive one, but is only calculated for the neighbourhood of great towns, where there is an ample command of manure, and a demand for potatoes. It appears from the experience of that neighbourhood, that there cannot be a better preparation for wheat than potatoes, nor one more valuable in respect to produce, and that the crop of clover afterwards, is abundant‡; but potatoes require a

* Communication from William Hunter, Esq. of Tynefield, in East-Lothian.

† Communication from William Hume, Esq.

‡ Yet in Northumberland, one of its most intelligent farmers, Mr. Bailey of Chillingham, states, that clover almost universally fails after wheat and potatoes, and the same has been found in Roxburghshire.—Perhaps a sufficient quantity of manure, with two such scourging crops, has not been applied. An experiment was tried in Ireland, to ascertain, whether potatoes was an exhausting crop or not. Four acres of land were equally well prepared, on two of which potatoes were planted with dung, which produced a good crop. The other two were fallowed, and dunged in the same propor-

great quantity of dung, and are not always marketable, while their value in the feeding of stock, is far inferior to turnips, in particular to Swedes.

Five Years' Rotation.—Rotations *of five crops*, have in many cases been recommended, both for strong and light lands.

Above fifty-seven years ago, the following system was adopted in the neighbourhood of Glasgow: 1. Potatoes; 2. Wheat; 3. Grass; 4. Pasture; 5. Oats. In this course, there were only two crops of corn, to three of green crops; and it was ably maintained, that when farmers were convinced, they would be as well paid by cultivating food for the use of cattle, as for man;—(from the increased quantity of manure procured under that system), the importation of corn into this country, would cease to be necessary. It is a safe maxim, that grain should only be sown, when the ground is laid down to grass, or ploughed from it*.

Upon mossy or peaty soils, after effectual draining, the following course is recommended: 1. Potatoes, or turnips; 2. Oats, barley, or bigg; 3. Clover; 4. Pasture; and, 5. Oats†. Peaty soils, however, are apt to get puffy by tillage, and require, in general, more pasture to consolidate them.

An experienced farmer in Huntingdonshire, considered the following course of crops preferable to every other: 1. A cleansing crop, of whatever kind, as best suited to the soil, as turnips, tares, or cole-seed, to be hoed, but not to

tion as the potatoe ground. Both were sown with wheat at the same time, when, to the surprize of every one, the potatoe ground produced the best crop of corn. There can be no doubt, that dung is brought into a more perfect state of putrefaction by being previously applied to a green crop, and more especially under a crop of potatoes, as it has the advantage of being effectually blended with the soil. The tops of the potatoes are also peculiarly fertilizing; and from shedding their decayed leaves, and excluding the surface of the soil from incessant heat, a quantity of vegetable mould is created on its surface. Hence it is, that the best crops of wheat have been produced, where the crops of potatoes have been *the most luxuriant.* This experiment was tried at the Viscount de Vesci's, Queen's County, Ireland.—*Communication from Edward Burroughs, Esq.*

* Mr. Curwen concurs in these sentiments. He remarks, in his Report to the Workington Society, anno 1816, p. 103, that the first lesson in modern husbandry is, to correct and controul too extensive ploughing, which is effectually done, by confining the tenant to alternate white and green crops. The proportion of green crops, with few exceptions, is too little, even in the best cultivated farms in this country. When this shall be fully understood, a great and essential point will be gained, and the progress of good husbandry will become very rapid.

† The potatoe-oat would be the most productive, but the red-oat is the best calculated for a peaty soil.

stand for seed; 2. A crop of white corn, of the kind best suited to the soil, to be laid down with seeds; 3. Clover, either grazed or mown; 4. Beans, where suited to the soil, to be sheep-fed and hoed, or some other meliorating crop adapted to the soil; 5. White corn suited to the soil; and he contended, that however various the soils, and however different in their nature, the same order or course of cropping ought to be pursued, (fen lands always excepted), changing only the species of the corn and vegetables, and adapting them to the nature of the soil to be worked upon, and the demand in the market, for the articles that are cultivated*.

It is obvious, that by such a system of cropping, a soil of tolerable natural richness, might not only be supported without foreign aid, but might increase in fertility. A certain degree of richness, however, is sufficient to produce maximum crops of grain. Land may be too rich, as well as too poor, for growing corn. The injudicious application of a few cart loads of manure, per acre, more than was required, has often rendered crops of wheat of little or no value. Upon lands made too rich, corn is very apt to lodge, which not only injures the crop of grain, but likewise destroys the clover and artificial grasses sown along with it†.

Six Years' Rotation.—Rotations of six crops, are peculiarly calculated for large farms. On small farms, and even large ones near great towns, where manure can be had in abundance, a succession of two, or of three crops, may be safely adopted‡. But on large farms, a variety of articles ought to be cultivated, by which the risk of loss, either

* Mr. Maxwell of Fletton, Huntingdonshire Report, p. 108. If the soil or climate is unfavourable to pulse crops, a second year of herbage would be preferable to beans or pease.

† Northumberland Report, p. 185, note. The danger of having the land too fertile, particularly from the hazard of rust or mildew, has been long remarked. Ellis, in his "Chiltern and Vale Farming explained," p. 200, has the following remark: "I also further prove, that these blights happen by the richness of the earth, and the wetness of the summer season; because the best wheat that England enjoyed this year, (an. 1732), grew on the poorest dry lands." When the straw is firm, and compact, rust is seldom experienced; but when it is large and porous, and full of sap, it seldom escapes.

‡ Middlesex Report, p. 183.—Mr. Greenhill of Stratford, in Essex, is said repeatedly to have had 600 acres of potatoes, 600 of wheat, and 600 of clover in one year, and thereby to have accumulated a large fortune. *Ditto.*—He had the good sense to discover, how much may be done by an intelligent farmer, who avails himself of the advantages he may derive from being near a metropolis, or a great market town.

from the weather, or the markets, is diminished;—less manure is required;—the labours of cultivation, can be more equally divided, during all the seasons of the year;—and fewer horses are necessary*.

This species of rotation may be considered under the three great divisions, of, 1. Clay lands; 2. Sandy lands; and, 3. Loams.

1. *Clay Lands.*—On wet or adhesive lands, which have been long in cultivation, a fallow, and in some cases a fallow-crop, once in six years, is strongly recommended; the favourite rotation being, 1. Fallow, winter tares, Swedish turnip, or cabbages; 2. Wheat; 3. Clover; 4. Oats; 5. Beans; 6. Wheat. In Suffolk, the years for producing the clover and the beans, are reversed†. But for reasons to be afterwards assigned, clover cannot be too near the fallow.

2. *Sandy Lands.*—A rotation of six, may also be adopted in sandy soils; as 1. Carrots, tares, turnips, or potatoes; 2. Barley, or oats, with seeds; 3. Hay, or soiling; 4. Pasture; 5. Pasture; 6. Oats‡. Under such a course, such soils become highly productive, and, instead of being exhausted, improve in fertility. The first year's grass ought not to be made into hay, unless where sheep have been fed on the ground, with the turnip crop, or the land is in good heart. Indeed, if the soil be thin, it should be pastured during the whole three years that it carries grass.

3. *Loams.*—On this species of soil the following plan is recommended: 1. Turnips, or fallow; 2. Wheat, or barley§; 3. Seeds, either clover alone, or clover and rye-grass, with the addition of a little yellow or hop clover: 4. Oats; 5. Tares, pease or beans; 6. Wheat‖.

Rich loams adapted to this productive rotation, will pay the

* Mr. Brown of Markle, in East-Lothian, has ascertained, that a pair of horses, properly fed, and regularly employed, under a judicious system, can carry on the cultivation of 50 English acres in a rotation of six; namely, 10 acres in fallow, or, on light soils, in turnips;—10 acres in wheat or barley, with either of which grass-seeds should be sown;—10 acres in oats, after these grasses;—10 in beans in strong soils;—and 10 in wheat.

† Suffolk Report, p. 51.

‡ The same rotation answers on light gravelly soils.—*Derbyshire Report*, vol. ii. p. 104.

§ It is the practice in Northumberland and the Lothians, to sow the winter species of wheats, more especially on light, friable, and warms soils, as late as the end of February, and even the beginning or middle of March, after turnips; but barley is sown after turnips consumed at a later period.

‖ The clover should be ploughed down before winter, and the oats sowed on the stale furrow, after being scarified. The stubbles should be *shimmed*,

highest rent of any, more especially when early oats are sown after clover, for invariably, on all friable soils, that grain is the most beneficial of crops, seldom producing less than 60 Winchester bushels per English acre, and much more profitable than wheat, which is apt to be blighted.

By this plan also, the crops are divided in a most advantageous manner. All the most valuable grains are grown, without any being twice sown in the same course, except a little barley, owing to a part being sown with it, after the turnips latterly consumed. Some farmers sow early oats after turnips, more especially in the northern districts, where oats are much in demand. But barley generally answers best to sow late after turnips, and oats are found on many soils, to succeed worse after turnips than any other grain. Besides, clover seldom succeeds with oats, rather better with barley, but usually the best with wheat sown in spring. Amongst barley, if not lodged, it will succeed; but from the rich state of the land, barley is apt to lodge (which circumstance ruins the seeds), except sprat or battle-door barley be sown, which seldom falls down. Grass-seeds rarely fail among spring-sown wheat, which is not so apt to lodge as winter, or autumnal-sown wheat, or perhaps any other grain. It is proper to add, that as the wheat is sown earlier than the barley or oats, so is the clover, and this early sowing, secures moisture, and promotes vegetation.

Seven Years' Rotation.—The following rotation is adopted in some of the rich deep soils of Suffolk: 1. Turnips; 2. Barley; 3. Beans; 4. Wheat; 5. Barley; 6. Clover; 7. Wheat. Under that system, the crops are said to be productive; the land to be clean, and to have the neatest possible appearance *.

Eight Years' Rotation.—Upon rich loams and clays, or where there is abundance of manure at command, a course of eight crops has been strongly recommended: 1. Fallow, with dung; 2. Wheat; 3. Beans, drilled and horse-hoed; 4. Barley; 5. Clover and rye-grass; 6. Oats, or wheat; 7. Beans, drilled and horse-hoed; and, 8. Wheat, or oats†.

according to the Kentish practice, (See Chap. IV. Part I. Sect. 24), and the land ploughed as early as the season will admit of it, after the crop has been harvested.

* Suffolk Report, p. 52, note. These protracted rotations, however, are much condemned by Mr. Middleton, as tending to promote weeds and exhaustion. He is of opinion, that they occasion the necessity of fallow, and the erroneous idea, that it is generally advisable.

† Brown's Treatise on Rural Affairs, vol. i. p. 464. The fallow, in this case, is only once in eight years.

This rotation is calculated to insure an abundant return throughout the whole period, provided dung be given to the clover stubble. Without that supply, the system would be crippled, and only inferior crops would be obtained in the concluding years of the rotation.

It is proper here to observe, that in none of those rotations are pease included, it being found by experience, that they will not succeed, above once in ten years, consequently they are chiefly adapted, for *protracted rotations*, or soils which are not of sufficient depth for beans, as light turnip soils, or thin weak clays. They are most likely to answer, when sown after grass, but even then, the crop is precarious, and is apt to encourage the growth of weeds*.

These observations are sanctioned by the authority of Mr. Coke, who, on weak soils, after the common Norfolk course of, 1. Turnips; 2. Barley; 3. Clover; 4. Wheat;—adopts the following, as a second rotation: 1. Turnips; 2. Barley; 3. Cocksfoot and other grasses, pastured; 4. Pasture; 5. Pease; and, 6. Wheat†.

Double Crops in the same Year.

In the vicinity of the metropolis, and in other parts of England, also in the neighbourhood of Edinburgh‡ and Aberdeen, double crops, in the same year, are raised on the same ground, not only in the gardens, but in the fields. There are many farmers near London, who manure for tares, and then have turnips in the same year, and next year wheat, by which they obtain three valuable crops in two years, which average from 16*l.* to 20*l.* per acre per annum§. Some farmers grow clover the third year, by which the average annual produce is kept up to nearly, if not quite, 20*l.* per acre. This system used formerly to be limited to a few fields near the farm-yard; but it now extended over

* General Report of Scotland, vol. i. p. 526.

† It would be more consistent with the principles of the alternate husbandry, to take a crop of oats after grass, and then pease. See Brown's Rural Affairs, vol. ii. p. 74.

‡ Two crops in the same year, are not very uncommon near Edinburgh, early potatoes, and turnips, being taken in the same year. Turnips may also be got after clover, especially when it has been cut for soiling.

§ Middlesex Report, p. 163.—In the southern parts of England, where the barley can be got off the ground in July, *transplanted Swedes* might be put in ground drilled to receive them, in the beginning of August, and the crop would be nearly as forward, as if they had been raised from the seed in May.

many whole farms*. In favourable seasons, what are called *stubble turnips*, are likewise occasionally raised†.

In Flanders, the system of double cropping is carried to a very great extent. On their light soils, they sow carrots in February, on a crop of wheat, sown with manure, in November. In other cases, they sow turnips after a crop of grain is reaped, slightly ploughing the land for that purpose; also spurry, for feeding milch cows, by which excellent butter is obtained; and with oats, they sometimes sow trefoil, or yellow clover, and get one good cutting of that crop, before it is necessary to plough the land. The quantity of manure which the Flemish farmer derives from these practices, is very great; and he is thereby enabled, to extract so much produce from soils, originally light and sterile, and which would soon revert to their former state of barrenness, without the greatest industry, and the most unwearied attention‡.

* Middlesex Report, p. 188.—Mr. Hutchins, and other farming gardeners in Kensington and Fulham, raise a succession of cabbages, and then potatoes or turnips the first year, and wheat the second year; and by repetition, they obtain these three valuable crops every two years.

† The variety called "*The stone turnip*," ought to be procured. A sandy loam is the soil where they thrive best. They should be sown very thick, *broad-cast*, as soon as the land can be got into good tilth. The success of the crop principally depends upon the long continuance of mild and growing weather, in October, November and December. Crops of stubble turnips near London have produced 10*l.* per acre, and upwards.—See *The Farmer's Journal*, published on the 13th September, 1819.

‡ Hints on the Agricultural State of the Netherlands, p. 71. The second, and in some cases, the preparatory crops in Flanders, are estimated at the following sums, in English money, per statute acre:

	Sterling Money.		
	£.	s.	d.
Carrots after Flax	5	3	10
Spurry after Wheat	6	2	0
Turnips after Rye	6	4	7
Turnips after Oats	6	4	7
Green Corn, *before* Flax	2	10	0
Green Corn, *before* Potatoes, per English acre	2	10	0

(*Vanderstraeten's Improved Agriculture*, p. 67).

Sometimes a farmer procures three crops in one year.—1. A crop of corn, to be cut green; 2. Flax, with which carrots are sown, or after the flax is pulled, turnips, spurry, or buck-wheat. If potatoes begin the course, they are preceded by a crop of grain, to be eaten green. The corn must be sown in winter, and cut in the beginning of May, when the cattle are very fond of it, as other green crops are so scarce.—(Ditto, p. 58). After a crop of coleseed, or hemp, spurry, carrots, or turnips are grown, and after wheat, a crop of carrots, sown with the wheat, or spurry, or turnips sown after the crop is reaped. Carrots, are also sown with rye, or turnip, or spurry, after the crop is cut down. It is indispensable to vary the immediate crops, and never to sow the same for two years in succession.—(*Vanderstraeten's Improved*

Rape is an excellent crop, to introduce in this manner, as it is more easily raised than any other green crop, and at a trifling expence. If sown immediately after the corn crop is cut, on good land, a crop of rape, that will afford a good bite for sheep, will be obtained for winter feed, and the land much improved for a succeeding crop of oats*.

Questions connected with judicious Rotations.

Before any general deductions are drawn from the preceding observations, it is proper to discuss the following points: 1. After a fallow on strong land, ought the succeeding crop to be wheat or barley? 2. After clover, are oats, or wheat to be preferred? 3. In a rotation, which includes beans and clover, where ought they respectively to be placed? and, 4. What is the best system for improving and preserving the fertility of weak soils?

1. In Essex, and many other counties of England, barley is the usual crop after fallow; and to render strong land better adapted for that plant, the fallow is frequently ploughed *eight* times. It is remarked, that when fallows are limed, the soil is so open, as frequently to throw out the young wheat; and that with barley, dung is often unnecessary, though in general required with wheat. The barley also, might be sown on the winter furrow in spring, and would be a productive, and not a precarious crop. The crop of clover afterwards, would likewise be great; if not destroyed by the weight of the barley crop, which is more apt to be lodged than wheat. About thirty years ago, barley used to be the first crop after fallow in Scotland. But, *the risk of losing the clover crop;*—the greater profit derived from wheat;—and the difficulty that would be found, to raise a sufficient quantity of that grain, for the demands of the British consumers, if wheat on fallows were universally given up, is unfavourable to the barley system. Besides, if it is necessary to plough the fallow eight times for barley, according to the Essex system, and only six times for wheat, that is a strong argument in favour of the latter practice.

2. In England, the culture of wheat, on a clover ley, is generally practised. The crop, however, is liable to great risk, from the depredations of wire-worms; and in Scotland,

Husbandry, p. 42). The moist climate, and mild winters of England and Ireland, are favourable to the plan of double crops.

* Communication from Edward Burroughs, Esq.

it has been clearly ascertained, that oats are a surer and more profitable crop, and that they leave the land in a better condition than wheat. Three methods, however, have been suggested, by which the mischief effected by the wire-worm might be obviated.

The first is, that of ploughing clover in the beginning of July, immediately after the crop of hay is taken off, or the land has been cut for soiling; then sowing it with rape or cole-seed, with one furrow, and after eating it down with sheep in September and October, to sow wheat. By this plan, the feed in September and October, compensates for the loss of the aftermath or pasture;—the ground is more sensibly enriched, than by the usual mode of pasturing;—the soil is brought into so mellow a state, that it can be drilled, if necessary;—while by the treading of the sheep, any insects in the ground are got rid of*.

The second mode of destroying such insects, is, by delaying ploughing clover stubble till December. If ploughed in October or November, the worms, when turned up, are able to creep again into the soil, where they lie dormant till revived by the warmth of spring, and then they prove extremely mischievous. But if exposed, in a torpid state, to the frost, and the inclemency of the season, they are speedily destroyed†.

The third plan is, to sow the wheat (even winter wheat accustomed to that culture), in spring, instead of winter. This may be done with success, so late as the beginning, or even the middle of March. The wheat thus raised, is generally as productive in quantity, but seldom so good in quality, as after turnips,—pease,—or beans. The plan, however, merits attention, as the attacks of worms are thus got rid of‡.

3. When beans and clover are included in the same rotation, the former should be placed near the termination of the course, and not at its commencement. Beans and clover, both draw their food from a considerable depth, and the one must therefore interfere with the nourishment re-

* Communication from Mr. Church, of Hitchill; Husbandry of Scotland, vol. i. p. 327. This idea, was first suggested by Mr. George Syme at Redkirk, near Annan.

† Communication from Mr. Hunter of Tynefield; Husbandry of Scotland, vol. ii. Appendix, p. 52. This opinion is strongly confirmed by the authority of Mr. Brown of Markle, who has, for several years, followed the practice recommended by Mr. Hunter, with equal success.

‡ Where this plan is tried, the seed wheat ought to be brought from Berwickshire, or the Lothians, accustomed to that mode of culture. A greater quantity of seed should be used, than if sown in the autumn or winter months.

quired by the other; but the clover, being the more important crop, is therefore entitled to the greater attention of the two. Besides, beans encourage the white snail, and that is a determined enemy to clover.

4. One method of increasing and preserving the fertility of weak soils, is, by having a division of them in pasture, thrown out of the usual rotation, for three, four, or five years, and then brought in again; so that in the course of a twenty-one years' lease, each division, in its turn, remains in grass for a period of time. In lands which are not naturally fertile and productive, this plan must be attended with very useful consequences. Every part of a farm, thus derives a proportional share of the advantage of being kept in grass, which is preferable to the plan, of preserving one part of a farm constantly in grass, and the remainder under cultivation.

General Deductions respecting Rotations.

The following important rules, in regard to rotations, are particularly recommended.

1. When any farm or district begins to be improved, it is necessary to commence with such crops as are the most likely *to produce manure.* Hence, barley ought to be avoided, as it yields, when compared to other crops, the smallest quantity of straw. Two exhausting crops also, should never be attempted in succession; if the soil has not acquired a considerable degree of fertility, or naturally possesses it, as is the case in regard to alluvial lands. Green crops are greatly to be preferred, as, from their greater bulk, they are more productive of manure, and go farther in supporting live stock. In similar soils and situations, green crops will furnish, at least, one-fourth, and in many cases, one-third more putrescent manure, than can be obtained from the straw of corn crops, grown on the same land. After green crops also, the weight and quality of the next crop of corn, are greatly improved, and it fetches a higher price at market.

2. The crops should be so arranged, that the labour of ploughing for each, and of sowing, weeding, reaping, &c. may proceed in *a regular succession;* by which the labour of cultivation is not too much crowded on the farmer, at any one season of the year, nor is any quantity of extra stock rendered necessary. All the crops produced on the farm, may thus be cultivated by the same labourers, (with the ex-

ception of hand-hoers in spring and summer, and assistants during the harvest), and with the same cattle*.

3. All forcing crops, or *frequent repetitions of the same articles or species, should be avoided;* as a diminution both in the quantity and the quality of the produce (except in very rare instances), is the usual consequence. Indeed, in soils of moderate fertility, as they are commonly cultivated, the greater distance, at which the repetition of any sort of crop can be kept, whether it be leguminous or culmiferous, the better is it likely to prove†.

4. Those crops should be raised which *are the best calculated for the extirpation of weeds.* The most effectual plan for that purpose, would be, (except on the richest soils), to cultivate *a greater proportion of green crops, than of grain.* By this means, a constant succession of large products may be secured‡.

5. As *a general system,* the most productive rotation, *on a light soil,* would be, 1. Winter tares, and *turnips sown early;* 2. Barley; 3. Clover, *and rape in July,* to destroy the wire-worm; and, 4. Wheat.—On strong soils, 1. Fallow, winter tares, or beans; 2. Winter-sown wheat, drilled, for the sake of the succeeding crop of seeds; 3. Clover; and, 4. Oats. In regard to more protracted rotations, they are objected to, as tending to render the land so foul, that it is difficult to cleanse it thoroughly, without a complete summer fallow.

It may be proper to add, that where the situation is high, and the climate humid, it is essential, not only to fix on a judicious rotation, but to raise those articles, which are most likely to thrive, under the hazard of backward seasons. In an upland farm, where the fixing of a proper rotation is of peculiar importance, the following system was recommended by an eminent farmer: 1. Turnips; 2. Bear, or bigg; 3. Clover; 4. Red oats, being the species of oat, from its rapid growth, the best calculated for such situations. Instead of the two-rowed barley, the four-rowed, or that inferior sort called bear, or bigg (*hordeum tetrastichon*), should always be

* A skilful farmer cultivates his wheat land in October; his beans in January; his oats in March; his barley in April and May; and his turnips in June or July; all with the same cattle.—*Gentleman Farmer*, p. 336.

† Mr. Andrew of Tillilumb, near Perth, finds, that if clover be cultivated only once in eight years, the produce is not only nearly double, but that the succeeding crop of oats is better, by eight bushels per acre.

‡ Middlesex Report, p. 196. For that purpose, tares and turnips, to succeed each other in the same year, are pre-eminent.

cultivated in unfavourable climates. Even in very high elevations, where other crops have failed, rye will prosper. If the soil be poor, it ought to be pastured for two years or more, before it is broken up for oats.

On the whole, the convertible system of husbandry, where a large proportion of a farm is cultivated for grain, and the remainder is employed in raising grass and green crops, is in general to be recommended. By the grain crops, a sufficient quantity of straw is provided, partly to be used as food, but principally, (under the improved system of husbandry), to be employed as litter for cattle; while at the same time, a fair profit is to be derived from the grain. By the grass and green crops, a number of domesticated animals are maintained, both in summer and winter; and when they are abundantly littered as well as fed, a regular and sufficient supply of valuable manure is secured. Hence it is, that alternate crops, for the food of man, and of the inferior animals, is in general indispensable, for the profitable production of both corn, and of animal food on all soils susceptible of cultivation. The superior advantages of that system, can only be questioned by those, who have had no opportunity of obtaining accurate information. These departments of husbandry, when they are conjoined, instead of being kept separate, reciprocally contribute to each other's prosperity*.

* General Report of Scotland, vol. iii. p. 224.—The advantages of this system are thus ably enforced by the intelligent Dr. Coventry. By selecting the proper species of plants for culture, and pursuing a proper succession, and regular order in raising them, land may be kept in a constant state of fertility. In this way cultivators, in common situations, *who may not have an extraneous supply of manure*, are able to sustain, and even to increase the productiveness of their arable lands; while at the same time, the fullest effect is given to the manure, when applied, by the soil being retained in a proper state of texture and cleanness; some species and proportion of crops, being more deteriorating or hostile to good tilth and perfect cleanness, than others.—*Coventry's Discourses*, p. 37.

PART II.

ON GRASS LAND.

THE variety of *grasses*, or esculent herbage, with which our fields are generally clothed, whether produced by nature, or by art, furnishes subsistence to a number of animals, subservient to the human race. From them man derives food, clothing, and other conveniences, in such abundance, that the skilful management of grass land, (on which their subsistence so much depends), is a subject of inquiry, which, next to that of land in arable cultivation, is essential for the interests of mankind.

But besides the immediate importance of grass, (more especially since the use of animal food has so much increased), its indirect effect on the production of corn, by communicating additional fertility to the soil, in the alternate courses of tillage and pasturage, is a most important consideration. It seems indeed beyond a doubt, that the soil not only obtains a recruit of food, for the nourishment of grain when cultivated, from the decayed herbage rotting on its surface, and the manure it obtains when pastured, but also acquires, a consistence favourable to fertility, while it remains in grass, defended from the variations of the seasons, under the protection of a close carpet.

The different particulars regarding grass, may be comprehended under the following heads: Upland pastures;—grass-lands of a medium quality;—rich permanent pastures;—the proper management of rich grazing lands;—that of natural hay meadows, and the mode of converting their produce into hay;—rowen, or after-grass;—fogging grass-lands;—transplanting turf;—cultivated grasses, and the means of consuming their produce, either by soiling, or making it into hay;—and the conversion of arable into grass-land, under the system of the alternate, or convertible husbandry.

1. *Upland Pastures.*

In several districts, where the management of stock is the most systematically conducted, the farmers have greatly improved upland pastures, by drawing surface-drains diagonally across the face of the hills, wherever injurious moisture appears. The produce of these pastures are thus rendered, not only more palatable and wholesome, but the

waters, by being conducted gently downward, in different small channels, are prevented from cutting those deep chasms in the hill sides, by which, in the times of heavy rain, the mountain pastures are often much injured*.

The next great improvement of which these tracts are susceptible, is that of filling the soil, with the earliest and most productive plants, that will grow in such soils and climates†. For that purpose, the ground, where it will admit of cultivation, ought to be ploughed, and laid down, after being limed, with the best grass-seeds, in particular with the most useful varieties of rye-grass, (*lolium perenne*), mixed with white clover, and the later flowering gramina.

Among the rules which judicious farmers practise, in regard to the management of upland pastures, the following deserve to be selected: 1. To inclose those pastures;—as the same extent of land, when sheltered, and properly treated, will feed a greater quantity of stock, and to better purpose, than when in an open and exposed state. 2. Not to overstock upland pastures;—for when this is done, the cattle are not only starved, and the quantity of herbage diminished, but the soil is impoverished. 3. When the pasture ground is inclosed and subdivided, so as to admit of it, the stock ought to be shifted from one inclosure to another, at proper intervals; giving the first of the grass to the fattening, in preference to the rearing stock. This practice tends to increase the quantity of grass, which has thus time to get up; and the ground being fresh and untainted, when the stock return to it, more especially if rain has fallen, they will feed with greater appetite and relish. 4. The dung dropt by the stock, while feeding, should be spread about, instead of its being suffered to remain, in a solid body, on the place where it was dropt. 5. Where the large, and the

* Messrs. Howlan, at their Merino sheep farm in Ireland, have improved 200 acres, in the following manner: A horizontal drain is first formed, at a considerable elevation on the hill, and a corresponding one at the bottom. The intermediate space is scored with the plough merely, in such directions as to catch the oozing from the upper drain, (which cuts off the water from a peat bog at top), and to convey that, as well as the surface-water, to the lower drain.—Then, in perpendicular and parallel compartments of 12 acres each, they lay on rock lime, at the rate of 40 beer barrels, of 32 gallons each, per acre, which is done at 1*s.* per barrel, including carriage. This saves breaking up, and laying down; and produces an immediate and wholesome pasture;—the lime causing the ground, though elevated, to yield white clover in abundance. Under this management, without the aid of turnips, it carries three sheep per acre all the summer.—*Communication from the Rev. Thomas Radcliff.*

† It is remarked that *hardy plants*, are of a coarser quality, more fibrous, less succulent, and less nutritious for live stock; but these must be resorted to in upland and hilly countries.

smaller kinds of stock, are to be fed on the same pastures, the larger species should have the first bite; and, 6. It is not thought by some advisable, to pasture land with a mixed collection of different species of live stock, unless the field be extensive, or unless the herbage varies in different parts of the field. It is generally found, that the grass produced by the dung of cattle or horses, is injurious to sheep, producing grass of too rich a quality, for that species of stock.

There is no mode by which such pastures are more effectually improved, than by the application of lime, either spread upon the surface*, or mixed with the soil. In the latter case, it is essential, that the lime should be mixed with the *surface soil* only; as lime is apt to sink, if covered deep by the plough. The coarse grasses would, in that case, regain possession of the soil, and the dung afterwards deposited by the cattle, will not enrich the land, in the same manner, as if the lime had been incorporated with the surface only†.

2. *Grass Lands of a medium Quality.*

There can hardly be a doubt, that a much larger proportion of the United Kingdom than is at present so cultivated, might be subject to the alternate system of husbandry, or transferred from grass to tillage, and then restored to grass. Much of the middling sorts of grass-lands, from 200 to 400 feet above the level of the sea, is of this description; and all well-informed husbandmen, and friends to the general prosperity of the country, regret, that such lands are left in a state of unproductive pasturage, and excluded from tillage‡.

In consequence of a requisition from the House of Lords, to the Board of Agriculture, in December 1800, a very extensive inquiry was made, "into the best means of converting certain portions of grass-lands into tillage, without exhausting the soil, and of returning the same to grass, after a certain period, in an improved state, or at least without injury;" and the information collected by the Board, upon

* Near Buxton, on the Devonshire estate, 1500 bushels of powdered or slacked lime, per acre, have been applied to the surface. The expence was 2*d.* per bushel, including leading and spreading. The effect, though slow, was striking, the heath being exterminated by the lime, and succeeded by a sweet and good herbage.—*Derbyshire Report*, vol. ii. p. 437.

† Communication from Mr. Dawson of Graden; Farmer's Magazine, for March 1812, p. 69.

‡ Coventry's Discourses, p. 127.

that subject, is in the highest degree satisfactory and important*.

From that inquiry it appears, that an acre of clover, tares, rape, potatoes, turnips, cole, or cabbages, will furnish, at least thrice as much food, as the same acre would have done, had it remained in pasture of a medium quality; and consequently, that the same extent of land, would maintain, at least as much stock as when in grass, besides producing, every other year, a valuable crop of corn; and this, independently of the value of the straw, which, whether consumed as litter, or as food for cattle, will add considerably to the stock of manure.

In discussing this subject, it is necessary to attend to the following particulars: 1. Whether any previous steps are necessary, before lands in grass are broken up. 2. The proper mode of effecting that object. 3. The course of crops. 4. The manure necessary. 5. The system of management during the rotation. 6. The mode of laying down the land again to grass. 7. That of sowing the grass-seeds; and, 8. The subsequent management.

1. If the land be wet, it is advisable to drain it completely, previous to its being broken up; for it is not improbable, that its being kept in pasture, was partly on account of its wetness.

Land that has been long in pasture, does not require dung, during the first course of crops that is taken after being broken up; but the application of calcareous manure is always, in such cases, expedient. Sometimes lime is spread on the ground, before it is ploughed; at other times, when it is either under summer fallow, or a drilled crop of turnips. Marl and chalk also, have been used for the same purpose, with great advantage. The land thence derives additional strength and vigour;—the succeeding crops are much improved;—the soil is commonly so softened in its texture, that it may be ploughed with half the strength that would otherwise be necessary;—and whenever it is restored to grass, the herbage is abundant†.

2. Wherever the soil is not too shallow, nor of a friable nature, or when the turf cannot soon be rotted, if land is to be broken up from old pasture, paring and burning is the proper system to be adopted. In this way, good tilth is speedily procured;—the damage that might otherwise be

* It is printed in the third volume of the Communications to the Board.

† Essay by Mr. Bridge, of Winford; Communications to the Board of Agriculture, vol. iii p. 612.

sustained by the grub, the wire-worm, and other insects, is prevented;—while the soil receives a stimulus, which insures an abundant crop.

Where paring and burning, from any circumstance, cannot take place, the land may be trenched or double-ploughed. This is effected, by means of two ploughs following each other, the first plough taking off a thin surface of about three inches, and the second going deeper in the same place, covering the surface sod with fine mould; both furrows not exceeding the thickness of the vegetable mould or other good soil*.

If the land is ploughed with one furrow, the operation ought to be performed before winter, that it may receive the benefit of the succeeding frosts, by which the success of the future operations will not only be promoted, but most of the insects lodged in the soil will be destroyed.

When one furrow alone is taken, the best size is four inches and a half deep by eight or nine broad. The strain on horses, in ploughing ley land, is mostly from the depth.

3. The rotation of crops to be adopted, when grass lands are broken up, must partly depend upon the soil, and partly on the manner in which it is prepared for cultivation. As a general principle, however, it may be laid down, that unless, by the course of cropping to be pursued, the bad grasses, and other plants indigenous in the soil, are extirpated, they will, when the land is again laid down to grass, increase and prevail, with more rapidity and effect, than the seeds chosen by the farmer; and the consequence must be, a heavy disappointment in the future crops of grass, perhaps solely, or at least principally attributable to a previous defective management†. It is necessary, therefore, to enter into details upon this subject, as applicable to clay;—chalk;—peat;—loam;—and sand.

Clay.—The process of conversion, in clayey soils, should be commenced with paring and burning, especially where the grub is suspected. The following course may then be adopted: 1. Rape, fed with sheep; 2. Beans; 3. Wheat; 4. Beans; 5. Wheat; 6. Fallow; 7. Wheat, sown with grass-seeds. This may seem severe cropping, but is justified by experience, when old grass clay land is broken up.

* Duckett's skim coulter plough does the same work, at one operation; but every farmer has not that tool in his possession; and as it requires four horses and two men, there is no saving in the use of it.

† Young's Essay; Communications to the Board of Agriculture, vol. iii. p. 131.

If the land has not been pared and burnt, the first crop ought to be either oats, or dibbled beans. To do justice to the plan of restoring the land to grass, there ought to be, in all cases, according to the soil, either a naked, or a turnip fallow, before the sowing of grass-seeds be attempted.

But on mellow, loamy clay-land, consisting of fine old grass pasture, where it is thought necessary or advisable to break up such land, it should be done in detached pieces, *so as to suit the convenience of the occupier*, and the following course should be adopted: 1. Autumnal ploughing for oats in spring; 2. Fallow for rape, to be eaten with sheep; 3. Beans; 4. Wheat, sown with clover; 5. Clover; 6. Clover; 7. Wheat; 8. *Rape* to be partially eaten, and hoed in spring, and to stand for seed; and 9. Wheat with grass seeds.—This is a very profitable rotation, and applicable to the best grazing land in Lincolnshire*.

Chalk.—Paring and burning is considered in this case to be indispensable, as a preparation for turnips, which ought, where manure can be got, to be raised two years in succession: then barley,—clover,—wheat; and after one or two additional crops of turnips, the land may be laid down with sainfoin to great advantage.

Peat.—On this soil, paring and burning is essentially necessary. Under a judicious system, the greatest and quickest profit is thus secured to the farmer, with advantage to the public, and without injury to the landlord. Draining, also, must not be neglected. The crops to be grown on peat soils, are, 1. Rape, or potatoes; 2. Oats; 3. Turnips; 4. Oats or wheat, and 5. Clover, or grass-seeds. A liberal application of lime, where it can be obtained†, is of the greatest service, in enabling such soils to bring corn to its full perfection.

In the fens of Thorney, &c. the following course was recommended by the late Mr. Wing: 1. Paring and burning for rape; 2. Oats, and 3. Wheat with grass-seeds, if the land was safe from water, the Lammas sort, if not, spring wheat. This short course, he contended, preserved the land in heart; and it afterwards produced abundant crops of grass. But long courses, in such a soil, run the land to weeds and straw, without quality in the grain‡.

Loam.—The courses of crops applicable to this soil, are

* Communication from Mr. Holdich.

† In Ireland, a quantity of limestone gravel answers the same purpose.—*Remark by Edward Burroughs, Esq.*

‡ Communication from Mr. Holdich.

too numerous to be here inserted. If the sward be friable, the following rotation may be adopted: 1. Oats; 2. Turnips; 3. Wheat, or barley; 4. Beans; 5. Wheat; 6. Fallow, or turnips; 7. Wheat, or barley and grass-seeds. If the sward be very tough and coarse, instead of taking oats, it may be pared and burnt for turnips.

Sand.—On rich and deep sandy soils, the most valuable crop that can be raised is carrots. For inferior sands, turnips, to be eaten on the ground, then to be laid down with barley and grass-seeds.

4. According to the improved system of laying down lands to grass, land ought to be made as clean and fertile as possible. With that view, all the green crops raised, ought to be consumed upon the ground; fallow, or fallow crops, ought not to be neglected, and the whole straw of the corn crops, should be converted into manure, and applied to the soil that produced it. Above all, the mixing of calcareous matter with the soil, either previous to, or during the course of cropping, is essential. Nothing generally improves meadows or pastures more than lime or marl. They sweeten the herbage, render it more palatable to stock, and give it more nourishing properties.

5. When turnips are raised upon light land, sheep should be folded on them; whereas, if the land be strong or wet, the crop should be drawn, and fed in some adjoining grass field, or in sheds. If the land be in high condition, it is customary to cart off half the turnips, and eat the other on the ground. But this is not a plan to be recommended on poor soils.

6. It has been disputed, whether grass-seeds should be sown with, or without corn. In favour of the first practice, that of uniting the two crops, it is maintained, that where equal pains are taken, the future crop of grass will succeed equally well, as if they had been sown separately; while the same tilth answers for both*. On the other hand, it is observed, that as the land must, in that case, be put into the best possible order, there is a risk, that the corn crop will grow so luxuriantly, as to overpower the grass-seeds, and, at any rate, will exclude them from the benefit of the air and the dews. If the season also, be wet, a corn crop is apt to lodge, and the grass will, in a great measure, be destroyed. On soils moderately fertile, the grasses have a

* Young's Essay; Communications to the Board of Agriculture, vol. iii. p. 142.

better chance of succeeding; but then, it is said, that the land is so much exhausted by producing the corn crops, that it seldom proves good grass land afterwards*. In answer to these objections, it has been urged, that where, from the richness of the soil, there is any risk of sowing a full crop of corn, less seed is used, even as low as one-third of the usual quantity; and that a moderate crop of grain, nurses the young plants of grass, and protects them from the rays of a hot sun, without producing any material injury.

Where the two crops are united, barley is the preferable grain, except on peat. Barley has a tendency to loosen the texture of the ground in which it grows, which is favourable to the vegetation of grass-seeds. In the choice of barley, that sort should be preferred, which runs least to straw, and which is the soonest ripe. On peat, a crop of oats is to be preferred†.

7. The manner of sowing the grass-seeds, also, requires to be particularly attended to. Machines have been invented for that purpose, which answer well, but they are unfortunately too expensive for the generality of farmers. It is a bad system, to mix seeds of different plants before sowing them, in order to have the fewer casts. It is better, to sow each sort separately, for the expence of going several times over the ground, is nothing, compared to the benefit of having each sort equally distributed. The seeds of grasses being so light, ought never to be sown in a windy day, except by machinery, an equal delivery being a point of great consequence. Wet weather ought likewise to be avoided, as the least degree of poaching is injurious. Grass-seeds ought to be well harrowed, according to the nature of the soil‡.

8. When the corn is carried off, the young crop of grass should be but little fed during autumn, and that only in dry weather; but heavily rolled in the following spring, in order to press the soil home to the roots. It is then to be treated as permanent pasture§.

By attention to these particulars, the far greater proportion of the meadows and pastures in the kingdom, of an in-

* Remark by Edward Burroughs, Esq.—This intelligent agriculturist has tried several experiments, which convince him, that sowing grass-seeds, without a crop of corn, is best calculated for the climate of Ireland, where there is such a risk, if the corn crop is very abundant, that it will be lodged in autumn.

† The Rev. Dr. Cartwright's Essay; Communications to the Board of Agriculture, vol. iii. p. 184.

‡ Middlesex Report, p. 302. § Ditto, p. 302.

ferior, or even medium quality, may be broken up, not only with safety, but with great profit to all concerned.

3. *Rich Permanent Pastures.*

There are various sorts of grass lands that ought not to be broken up; as water-meadows;—salt-marshes;—lands apt to be overflowed;—lands near large populous towns, where the produce of grass land is always in demand, and consequently dear;—and low lying tracts, in the valleys of mountainous countries, (particularly in chalky districts), where old meadow land is scarce, and where a portion of it, to raise early and late food for stock, gives a great additional value to the adjoining upland. But whether *rich lands*, which have long remained in grass, and continue productive, should ever be converted into tillage, is a question respecting which a great diversity of opinion has been entertained.

In order that the reader may be the better enabled to determine a question so much controverted, we shall proceed to give a concise description, of the nature and quality of the several sorts of land, usually retained in the state of permanent pasture; the conversion of which into tillage, has been so much deprecated; and also a short statement of the advantages which such lands are supposed to possess.

The lands considered as best adapted for permanent pasture, are of three kinds: 1. Strong tenacious clays, unfit for turnips, or barley; which are said to improve the more, the longer they are kept under a judicious system in grass*. 2. Soft clayey loams, with a clayey or marly bottom or substratum†; and, 3. Rich sound deep-soiled land, or *vale land*, enriched by nature at the expence of the higher

* This assertion is thus explained. In the course of years, on the surface of such a soil, there is formed a rich, light, black mould, two or three inches in thickness, which is the matrix of these rich grasses. When the soil is ploughed up, this valuable surface is mingled with the colder and less fertile strata below, and cannot be renewed for many years. *Young's Essay;* Communications, vol. iii. p. 191.—It is contended, on the other hand, that strong clays do improve, when first sown down with grass, and that by repeated trials, it has been completely ascertained, that such soils will yield as much grass the first year after they are sown, as in the two following years. Hence, instead of keeping them in grass, it is desirable, frequently to break them up, and to stock them with fresh plants.—*Communication from Robert Brown, Esq. of Markle.*—But the question is, if a rich surface *has been got*, should it be destroyed?

† Wilkes's Essay; Communications to the Board, vol. iii. p. 319.

grounds, generally lying in a situation favourable with respect to climate*.

The advantages of such pastures are represented in the strongest light. It is affirmed, that they feed cattle to a greater weight;—that they are not so easily scorched by the summer's drought;—that the grasses are more nutritive both for sheep and cattle;—that milch cows fed upon them give richer milk, and more butter and cheese;—that the hoofs of all animals pastured on them are much better preserved;—that they produce a greater variety of grasses;—that when properly laid down, they yield a succession of pasture throughout the whole season;—that the herbage is sweeter, and more easily digested;—and that they return an immense produce at a trifling expence.

To break up lands possessing these advantages, it is said, can only be justified by the most urgent public necessity, and to prevent the horrors of famine.

The real value of such lands will appear, by considering their rent and produce.

The grass lands in Lincolnshire, are accounted the richest in the kingdom. The rents are various, from 1*l.* 15*s.* to 3*l.* per acre, and the value of the produce from 3*l.* per acre, to 10*l.* 8*s.* This produce arises from beef, mutton, and wool, and is obtained, subject to little variation from the nature of the seasons, and at a trifling expence.

The stock maintained per acre *on the best grazing lands*, surpasses what could be fed by any arable produce†. It is not at all uncommon to feed, at the rate of, from six to seven sheep, in summer; and about two sheep in winter. The sheep, when put on the grass, may weigh from 18 lbs. to 20 lbs. per quarter, and the increase of weight would be at the rate of 4 lbs. per quarter, or 16 lbs. per sheep. But suppose, in all, only 100 lbs. at 8*d.* per pound, that would amount to 3*l.* 17*s.* 10*d.* The wool would be worth about two guineas more, besides the value of the winter keep, and the total may be stated at about seven pound per acre, got at little expence. Such lands, it is evident, cannot be better employed than in feeding stock‡.

* Coventry's Discourses, p. 125, note; Wilkes of Measham's Essay, Communications, vol. iii. p. 319. In that kind of soil, no cracks or fissures are to be met with, even in the driest summers.—*Lincoln Report*, p. 72.

† In Scotland, such rich grazing land as that to be met with in England, is hardly known. "The richness of the soil is hardly credible to those who have not seen it."—*West Riding Report*, Appendix, p. 5, and p. 9.

‡ Lincoln Report, p. 219. In the dairy, good grazing land will produce 5 cwt. of cheese per acre. Wilkes's Essay; Comm. vol. iii. p. 320; Derby-

Grass land of the first and second kinds, the *tenacious clays*, and *heavy loams*, when brought, in a succession of years, or perhaps of ages, *into a state of great productiveness*, cannot be ploughed, without the risk of great injury, and are more profitable, in the production of herbage, than they could be in the production of grain.

Lands of the third kind, or *the deep-soiled sound vale lands*, would be productive of corn if ploughed; but would probably be injured by cultivation; from their texture being altered, and rendered unduly loose and open by tillage;—from the native plants being more or less destroyed or enfeebled;—and from the great decomposition, and waste of the principles of fertility resident in the soil*.

The extent of these three descriptions of land, however, is not so great, that the advantages of breaking them up, could probably ever be a national object; or worth the risk of injuring their future productiveness in grass. But there are pasture lands of an inferior sort, which are too apt to be confounded with those already described, and respecting the propriety of occasionally appropriating them to arable culture, there can hardly be a doubt. Such lands do not depend upon their intrinsic fertility, but upon *annual supplies* of manure, derived from the arable land in their neighbourhood†.

The question then is, whether it is most for the advantage of the parties interested, that one half of a farm should be in perpetual grass, and the other half in perpetual cultivation; or the whole alternately, under grass and grain, and subjected to convertible husbandry, with the exception of the rich grazing lands above described?

The objections to the division of a farm, one-half into *permanent grass*, and the other half into *permanent tillage*, are very great. The arable is deteriorated, by the abstraction of the manure it produced, if applied to enrich the grass; while a part of the manure thus employed, is wasted;

shire Report, vol. iii. p. 44. In general, however, 4 cwt. of cheese, is considered to be a fair produce. The strongest grazing lands do not produce cheese of the best quality.

* Coventry's Discourses, p. 125, note. It is not improbable, that such soils would be found admirably calculated for lucern, the produce of which would be much more valuable than any crop they can yield in their present state.

† The economy of procuring hay from meadow grounds, recruited by top-dressings, is doubtful; and this valuable article, had better, in most instances, (in nineteen out of twenty), be raised from lands, usually under tillage, and yielding our ordinary arable crops, in some regular order.—*Coventry's Discourses*, p. 100.

for spreading putrescent substances upon the surface of a field, *if done at an improper season*, is to manure, not only the soil, but the atmosphere*. The miserable crops of corn produced, where this system prevails, sufficiently prove its mischievous consequences.

So injurious is this mode of management, that of impoverishing the arable land, for the sake of the grass, that in the opinion of experienced farmers, the landlord loses one-fourth of the rent he otherwise would get, for every acre thus debarred from cultivation; while the public is deprived of 3¼ bushels of grain, for every stone of beef or mutton thereby obtained†.

This is a point that cannot be too much inculcated, in a country increasing in population, and which finds it necessary, to import foreign grain, for the maintenance of its inhabitants. For with the exception of rich pastures, arable land is, on an average, superior to grass-land, with respect to furnishing articles of human food, in the proportion of three to one‡; and consequently every piece of land, unnecessarily kept in grass, the produce of which will only maintain one person, is depriving the community of food, capable of maintaining two additional members. Many respectable farmers, however, are partial to the top-dressing of meadows, and of pastures, with dung, and where it can be accomplished, without robbing the arable land, the objections to it may be got over by judicious management. Mr. Middleton recommends for that purpose, that the dung should be spread on the grass land *in October*, just before the expected falls of rain, which generally occur at that season of the year, and which will wash the dung into the soil. The loss would not then be material, and might be totally avoided, if composts were made use of§.

Landlords, in many parts of England, are apt to be apprehensive, that their interests may suffer from a change

* Berwickshire Report, p. 136.—The loss is less material, when the dung is spread on the grass land *in October*, just before the expected fall of rain sufficient to wash it into the soil.—*Remark by John Middleton, Esq.*

† See the opinions of Mr. Rennie of Phantassie, and Mr. Brown of Markle.—*Husbandry of Scotland*, vol. ii. p. 35, 37.

‡ Young's Essay, Comm. vol. iii. p. 110.

§ The practice of top-dressing has become very general in Ireland. The manure is turned out in the months of August or September, and it is found that land so treated continues a long time fertile. It is there considered to be an advantageous mode of reclaiming grass-lands, and should compost manure be used, instead of pure dung, it will make the improvement cheaper and more effectual.—*Remark by Edward Burroughs, Esq.*

of system*; and it is much to be lamented, that the law scarcely does afford them adequate protection for their property, against tenants who are inclined to break through their engagements. Were it not for this circumstance, the interests of the landlord might be sufficiently guarded against injury, by judicious covenants, and by prescribing an improved management. A regular system of convertible husbandry, might thus be established, by which the value of landed property, would not only be greatly augmented, but the true interests of the country be most essentially promoted.

The principal objection, to the conversion of old turf into arable land, arises, from an alleged inferiority in the new, when compared to the old herbage; a complaint, which probably originates, either from the improper choice of seeds, or from giving them in too small quantities, thus favouring the growth of weeds. A gentleman who had a large farm, principally consisting of strong rich clay, (every field of which, with hardly an exception, he occasionally broke up), was accustomed to lay them down with a crop of barley, and to sow fourteen pounds of white clover, a peck of rib-grass, and three quarters of hay-seeds per acre. By this liberal allowance of seed, he always secured a thick coat of herbage the first year, which differed from old pasture, *only in being more luxuriant.* Such lands, therefore, under judicious management, will rarely be injured by the plough. When laid down from tillage into grass, they may not carry, for the first year or two, such heavy cattle as they would afterwards, but they will support *more in number*, though of a smaller size†, and bring a greater weight of butcher meat to market.

It is often desirable, to keep one or two moderate-sized inclosures, of from ten to twenty acres, according to the size of the farm, in perennial pasture, for the feeding of cattle and sheep; and as a resource for the stock to go to,

* Derbyshire Report, vol. ii. p. 39, and 175.

† Dr. Cartwright's Essay; Communications to the Board of Agriculture, vol. iii. p. 131. The Doctor is certain, that *three quarters* of hay-seeds were used per acre, collected from common meadow-hay, probably one half of which had lost the power of vegetation, by being overheated in the stack, and a great portion of the remainder had never been sufficiently ripe. Hence the necessity of sowing what appears to be such a superabundant quantity. The price was then, (about 50 years ago), from 3*s.* to 4*s.* 6*d.* per quarter. It is a pity, that instead of a mixture of hay-seeds, in so imperfect a state, persons were not employed to collect only those worth the sowing, and perfectly ripe.

in case of a severe spring, or summer drought; but the retaining of any considerable portion of a farm in old turf, or permanent pasture, unless of the richest quality, is, in general, injurious to the landlord, the tenant, and the public. The value of any estate, where the system of permanent pasture has been carried to an unreasonable extent, may be easily and greatly augmented, by appropriating the manure of the farm, to turnips and other green crops, and by the adoption of the convertible system of husbandry.

There are many cases, however, where this doctrine, though in general to be recommended, ought not to be carried to an extreme. It is remarked, that in Norfolk, where the land is commonly light, and where sheep are both *bred* and *fed* upon the same farm, a proportion of permanent pasture is essential. Much injury in particular has been sustained, by breaking up permanent pastures, on such soils, more especially when subject to rectorial tithes. Many lands of an inferior soil, which kept two sheep on an acre, paying only vicarial tithes, and rented at ten shillings per acre, since they have been broken up, cannot pay, even without rent, the tithe of corn, and the expence of cultivation. A farm in general lets best, with a fair proportion of grass land upon it, which admits of a mixed management, in consequence of which, if one object fail, another may be successful*.

4. *On the Management of Rich Grazing Land.*

The rules for the management of rich grazing land, are neither numerous, nor difficult to execute.

1. The sorts of manure, and the season for applying them to grass land, are first to be considered. Light dressings, such as soot, coal-ashes, peat or wood ashes, lime, malt-dust, &c. are often highly beneficial, if applied in February or March, when the weather is dry enough to admit the application, without poaching the ground; but as they do not suit all soils, their efficacy should be tried by experiments, before much expence is incurred†. As there are strong objections to the application of pure dung to grass lands, (much of its strength being evaporated, from its being ex-

* Communication from Mr. Blaikie at Holkham.
† Young's Calendar, p. 87.

posed to atmospheric influence*), composts are greatly to be preferred. They may be applied, at the rate of from 30 to 40 cubic yards per acre. To keep grass land in good condition, a dressing to this amount, is required every four years†. The application of unmixed putrescent manure, will thus be rendered unnecessary‡, which ought at least to be avoided, in meadows appropriated for the feeding of dairy cows, from its affecting the quality of the milk.

2. Attention to the weeding of grass lands, has been already recommended§. It is likewise necessary to clear them of all rubbish likely to affect the young grass, such as the cones of ant-hills;—sticks and bushes left after hedging, or strewed by the wind;—also, every thing that may injure the stock, if pastured, or that can obstruct the scythe, should it happen to be used. If mole-hills are spread about with a spade, or bush-harrow, the grass will be improved‖.

3. Rolling was formerly considered as indispensable, in the management of grass lands, tending to smooth and consolidate the surface;—to prevent the formation of ant-hills;—to promote the growth of valuable herbage;—and to render the effects of drought less pernicious. But *scarifying* the turf with a plough, consisting only of coulters, or harrow-teeth, so that the whole surface may be cut or torn, is to be recommended, *when the pastures are hide-bound.* That tenacious state, rolling tends to increase; whereas by scarifying, the surface is loosened, and the roots acquire new means of improved vegetation. This operation seems particularly useful, when it precedes the ma-

* In the northern counties of England, it is usual to cart the dung on their pasture land, in time of frost, that they may not injure the sward, and having more leisure at that period of the year. This practice is justly reprobated by the intelligent Dr. Fenwick. While the frost lasts, the land can derive no advantage from the manure, and when a thaw supervenes, it is evident, that the wash from melting snow, or from the rains which generally fall in such weather, must deprive the mass of every part that is soluble: the ground, in the mean time, retains the frost for many days, and is therefore incapable of absorbing the wet, which falls upon its surface; and even when the influence of the milder air has reached it, can imbibe but little, being in general previously filled with water, and the quantity which flows over it, being too great for the soil, under any circumstances, to drink up.—*Dr. Fenwick's Essays*, p. 23.

† See Greenall's Observations on Composts; Comm. vol. iii. p. 290; also Derbyshire Report, vol. ii. p. 184.

‡ Those who apply putrescent manures, with the best effect, prefer moderately moist and warm weather, that the dung may be quickly covered.—*Derbyshire Report*, vol. ii. p. 185.

§ Chap. III. Sect. 7.

‖ Young's Calendar, p. 221.

nuring of grass-lands; for if well scarified, the ground is so opened, that any manure spread on it, gets at once to the roots, consequently a small quantity thus applied, goes as far, as a larger one laid on in the old mode, and without such an operation.

4. When land of a retentive quality, is pastured by cattle or horses in wet seasons, it receives much injury from their feet. Every step they take, leaves an impression, which rain fills with water, and then the hole stands full like a cup. This wetness destroys the herbage, not only in the hole, but that also which surrounds it, while at the same time, the roots of the grasses, as well as the ground, are chilled and injured. No good farmer, therefore, will permit any cattle to set a foot on such land in wet weather, and few during the winter months, on any consideration. Sheep are generally allowed to pasture on young grasses in dry weather, from the end of autumn to the beginning of March; they are then removed; and it rarely happens, that any animal is admitted, till the weather be dry, and the surface so firm, as to bear their pressure, without being poached or injured.

5. One of the greatest difficulties in the management of old pasture lands, is, to prevent that immense growth of mosses, (*hypna*), by which the finer species of grasses are apt to be overwhelmed. Drainage, and the use of rich composts, are in this case necessary. Harrowing, and cross-harrowing, with a common harrow, loaded with a weight, so as to go from one to two inches deep, with a sprinkling of grass-seeds afterwards, and some lime*, or well prepared compost, are the most likely means of destroying the moss, and improving the pasture. Feeding sheep with oil-cake, and allowing them to pasture on the land, has also been found effectual for the destruction of moss, and bringing up abundance of grass†. But the radical remedy is, to plough up such grass lands, upon the first appearance of moss, or before it has made any considerable progress.

6. Rich pastures, in general, should rarely be mown. Many valuable marsh-lands have been injured by that practice, for they seldom afterwards fatten stock so well‡. If cut, the mowing should take place early in the season, before the grass-seeds ripen, and the aftermath should only

* Derbyshire Report, vol. ii. p. 196.

† Communication from John Middleton, Esq.

‡ Lincoln Report, p. 222.—Any patches of coarse grass may be removed by the scythe.

be fed lightly by sheep, whose droppings are more fertilizing, and do not scald the crop, as those of black cattle.

In some cases, however, rich grass lands, *when annually mown*, become subject to weeds; for it tends to encourage moss, and gives advantage to the stronger rooted grasses, which gradually change, and deteriorate the nature and quality of the herbage. The bottom becomes thin, the white clover disappears, and coarser plants occupy the ground. When this takes takes place, the pasture should be fed, instead of being mown, for the space of two or three years, until the weeds have been subdued, and the finer grasses re-appear*.

In regard to the plan of mowing and feeding alternately, it is a point much disputed among intelligent agriculturists. By adopting that system, a farmer, it is said, may go on longer, without the application of manure, but his fields, in the end, will be ruined by it. It is contended, that to maintain a proper quantity of stock, the land must be accustomed to keep it, particularly in the case of sheep;—that where land has been used to the scythe, if manured for pastures, it will often produce more grass, but that grass will not (*cæteris paribus*), support so much stock, nor fatten them nearly so well;—and that old pasture will not produce so much hay, as land that has been constantly mowed; for each will grow best *as they have been accustomed to grow*, and will not readily alter their former habits†. On the other hand, it is asserted, that many experienced farmers, prefer the system of feeding and mowing alternately, as they find, that under that system, the quality and quantity of the hay has been improved; and the pasturage, in the alternate year, has been equally sweet and productive‡.

7. It is a most important point to ascertain, in what cases cutting, or feeding, is most beneficial. If fed, the land has the advantage of the dung and urine of the pasturing stock; but the dung being dropt in irregular quantities, and in the heat of summer, when it is devoured by insects, loses much of its utility. If the dung arising from the herbage, whether consumed in soiling, or as hay, were applied to the land, in one body, and at the proper season,

* Communication from Mr. Holdich.

† Essay by Charles Goring, Esq.; Communications to the Board, vol. iii. p. 191.—This rule ought probably to be adopted with respect to the pastures of Rutlandshire, let to cottagers for keeping their cows, see Chap. II. Sect. 5, p. 86.

‡ Communication from Edward Burroughs, Esq.

the operation would be more effectual. The smother of a thick crop, continued for any time upon the ground, greatly tends to promote its fertility; and it has been pretty uniformly found, after repeated trials, upon soils of almost every description, that oats taken after clover that has been cut, either for soiling or hay, is superior to the crop taken after clover pastured by sheep*.

5. *Of Natural Hay Meadows.*

There are three descriptions of these meadows:—1. On the banks of streams and rivers; 2. On the uplands, or more elevated grounds; and, 3. Bog meadows.

1. Were the water-side, or low flat meadows judiciously inundated, when the stream is turbid with earth, or manure washed into it from the country through which it passes, they would reach a high degree of fertility†; but being rarely protected by embankments, and frequently overflowed at improper seasons, the soil is often chilled;—the best grasses destroyed, and a worthless herbage becomes substituted in their place. This is particularly the case with common-field meadows, whose drainage is likewise in general neglected. Such meadows, produce about a ton of ordinary hay, and let for about 25*s*. per acre. If they were inclosed, embanked, and properly drained, they would probably be as well worth from 3*l*. to 4*l*. per acre‡.

In some cases, low flat meadows have been improved by the application of sand, at the rate of from 10 to 15 tons per acre; but the sand must be spread carefully, and applied at different seasons, so as to prevent any risk of the grass being smothered by an unequal distribution§.

The advantage of protecting such meadows from useless, and often ruinous inundations‖, having been already treated of (Chap. III. p. 285), it is unnecessary to dwell upon the

* See the evidence of this fact, on the authority of Mr. Brown of Markle and Mr. Hume of East-Barns. Husbandry of Scotland, vol. ii. p. 13; also Young's Calendar, p. 357.—This is confirmed by the experience of Mr. John Webb.—*Derbyshire Report*, vol. ii. p. 158.

† Derbyshire Report, vol. ii. p. 494. ‡ Middlesex Report, p. 219.

§ This plan has been tried in Norfolk, with very great success. Meadows have there been done over with sand, by which the quantity and the quality of the grass were greatly improved; whereas a portion of the same meadow, left in its former state, was quite worthless.

‖ In Derbyshire, as a protection of stock from inundations, it is not uncommon to raise mounds of earth in each meadow, two or three yards high, for the cattle to retire to, in case of a sudden flood.—*Report*, vol. ii. p. 176; they are called "*safety-mounds.*"

subject in this place. The management of upland meadows producing natural grasses, shall therefore be discussed.

2. The upland meadows of Middlesex contain about 70,000 acres, or $\frac{7}{18}$ parts of that county. The soil being of a tough and gluey nature, and much mixed with flinty gravel, was ill adapted to tillage; but having been cleared of rubbish, and laid down to grass, and manured by the rich dung of the metropolis, in a higher degree than any other meadow land in the kingdom, it became, and has long continued to be, meadow of the first quality.

Manure is almost invariably laid on the meadow land of Middlesex, about the month of October, while it is sufficiently dry to bear the drawing of loaded carts without injury, and when the heat of the day is so moderated, as not to exhale the volatile parts of the dung*. At that season of the year, rains generally occur, which force the dung into the soil. Where such quantities of dung can be had, the same caution in the use of it, or the mixing it in composts, is not so necessary as in other cases.

This extensive tract of *clay land*, would have been of very little value, if attempted to be kept in cultivation. The difficulty in tilling it,—the expensive teams which must have been employed to subdue land of a quality so peculiarly stubborn,—the short periods in the year when it could be ploughed with success,—and the uncertain produce of such a soil, are circumstances, which would have greatly kept down its value; but converted into permanent meadow, and enjoying the advantages of vicinity to the metropolis, (which renders grass land more valuable than arable), its rent has been raised from 3*l.* to 5*l.*, or 6*l.*, and, in some cases, to 7*l.* per acre. Nay, a few acres, for accommodation, have fetched as high as 10*l.* On a medium of seasons, this land produces, besides the aftermath, two tons of hay per acre, of the very best quality, for the feed of horses†.

Meadow land for cows, is generally mown two, or even three times in a summer. The grass is rarely permitted to stand till the seedling stems fully rise, the great object, in this case, being, to procure hay of a soft grassy quality. It is generally mown the first time each season, early in May, from two to four weeks sooner than it would be advisable

* Middlesex Report, p. 223.

† The excellent quality of the hay, in these meadows, is supposed to be greatly owing to the absence of broad and thick-leaved plants. They are apt to turn black, mould in the stack, and greatly injure the whole crop.—*Derbyshire Report*, vol. ii. p. 197.

to do, if the hay were intended for the support of horses*. In all other cases, good farmers never think of mowing their meadow lands more than once a year, unless they have, or can easily procure, dung sufficient to cover the ground, immediately after the second mowing. In general, where hay for horses is the object, it is thought most advisable, to mow but once, and to feed all the after-grass, with a view of increasing the principal crop of the following year†.

The mode of making hay in Middlesex, being considered the most systematic and perfect of any hitherto known, a general account of it shall be given in the Appendix.

Stacking Hay.—This important operation is done, in many parts of England, with peculiar care and dexterity. The stacks are frequently round, and the sides, and part of the roof, is brought to the most regular form, by hand-pulling, so that no rain makes any impression upon the stack. The hay thus pulled, is used to top the stack or cock; and, on the whole, answers the purpose better than straw, which is not so pliable, and unless done with great attention, is apt to admit water‡.

Salting Hay.—The salting of hay, at the time of stacking, has been practised in Derbyshire§, and in the North Riding of Yorkshire‖. The salt, particularly when applied to the second crop of clover, or when the crop has received much rain, checks the fermentation, and prevents moulding. If straw be mixed with the hay, the heating of the stack is still further prevented, by the straw imbibing the moisture. Cattle will eat, not only such salted hay, but even the straw mixed with it, more eagerly, than better hay not salted, and also thrive as well upon it. The quantity recommended is, a

* Middlesex Report, p. 224.

† Mr. Curwen does not view these meadows in the vicinity of London, in the same favourable light, as the intelligent Reporter of Middlesex; on the contrary, he laments, that so much rich ground, surrounding the metropolis, should principally be dedicated to the production of hay, instead of being applied to the raising of green crops, when manure is ready and on the spot, without distant carting; which in other districts, is often carried above twenty miles, for that special purpose. Every field now permanently appropriated to hay meadows, might, he maintains, under proper management, be made to produce turnips, tares, and wheat; by which the produce of food from the soil, would be augmented above *four fold*, not in quantity only, but in effect. There can be no doubt, that every acre near London, might be made to yield from thirty to forty tons of green food, instead of its present produce, in dried hay, of about two tons per acre; and the addition of a little aftermath, from which little profit is derived.—*Report*, p. 68.

‡ Derbyshire Report, vol. ii. p. 180. § Ditto, vol. ii. p. 182.

‖ North Riding Report, p. 177. Perhaps it would prevent firing entirely.

peck of ground rock salt, to a ton of hay. By this application, hay that had been flooded, was preferred by cattle to the best hay that had not been salted.

Bog Meadows.

In many of the hilly and pastoral districts of the kingdom, bog meadows are still considered by the farmer, as an important acquisition. In some cases, the grass is of so soft a quality, that it is difficult to convert it into hay. To prevent its being consolidated in the cocks, it must be frequently opened up, and when the weather permits, completely exposed to the sun and wind; this sort of grass, being only capable of sustaining a very moderate degree of fermentation.

When the natural herbage, however, is of a coarser description, it may be put into small cooks, in rather a green or damp state, so as to go through the progress of "*a sweating*," or slight fermentation. The woody fibres in coarse hay, are thus rendered more palatable and nutritious, while its condition for becoming fodder, is considerably improved: but when any warmth becomes perceptible, if the weather will permit it, the hay should be spread out, and put into large cocks the moment it is in a dried state*.

In the moister pastoral districts, in the north-west parts of Scotland, *hay-barns* are necessary, the construction of which is as open as possible, for the purpose of *drying*, as well as preserving the hay†. In some of these districts, a curious device has been fallen upon, of making the hay, when dried, into ropes of two fathoms in length, and then twisted twofold. Being thus compressed, less room is required in the barn, and in this shape, it is carried, with greater facility, to distant glens, for the use of cattle during stormy weather‡.

6. *After-Grass, or Rowen.*

After-grass, in Middlesex, is often let by the farmer, at about 20*s*. per acre, to be fed off by heavy cattle, till such time as the land would run the hazard of being injured by their poaching, were they continued in the field. It is well known, wherever a bullock makes a hole with his foot in a

* General Report of Scotland, vol. iii. p. 13.
† Inverness Report, p. 193.
‡ Statistical Account of Scotland, vol. vi. p. 248.—Parish of Kintail.

clayey soil, it holds water, and destroys the herbage, which is not quite replaced, till several years after the hole has grown up. When the cattle are removed, sheep are kept till Candlemas. Sometimes they are permitted to consume the whole after-grass, at from 3*s.* to 5*s.* per score per week.

In some districts, rowen, or *the second growth of grass* after the hay is mown in July, is preserved from every species of stock, until the spring months, or the beginning of May, when it is fed with sheep. Where there are no water-meadows, this seems to be the most valuable resource that the sheep farmer can resort to. The value of aftermath, as usually consumed, is inconsiderable, not worth more than from 7*s.* 6*d.* to 15*s.* or 20*s.* per acre. Tolerable rowen, will carry five, in some cases even ten ewes per acre, with their lambs, throughout the most pinching periods of the spring, when the turnips are done, and the forward grasses are not ready. It is therefore well worth from 30*s.* to 40*s.* per acre, at that period of the year, and in severe and backward seasons, it must prove of still higher value*.

7. *Fogging Grass Lands.*

In the original Report of Cardiganshire, a practice is recommended, to which the term of *fogging* is applied. Under that system, fields in pasture, are shut up early in May, and continued in that state till November or December, when the farmer's stock is turned in, and continue to pasture, till the May succeeding†. Such management, however, can only be advisable on a soil of the driest nature, which will not be injured by poaching in the wettest seasons.

8. *Transplanting Turf.*

This is a new practice in agriculture, originally attempted in Norfolk‡, whence it is spreading to other districts. By this process, a piece of good, clean, sweet old turf, which ought principally to consist of fibrous rooted plants, is cut into small pieces, of about three inches square, and placed, about six inches apart, on the surface of ground prepared

* Suffolk Report, p. 213. Young's Calendar, p. 208. Derbyshire Report, vol. ii. p. 183.

† South Wales Report, vol. i. p. 545. It is said, that, by this practice the stock are kept in good condition, and expence is saved.

‡ Mr. John Blomfield of Warham, a tenant of Mr. Coke's, has the credit of originating this novel practice.

for that purpose. In this way, one acre of turf*, will plant nine acres of arable land. The pieces of flag should be carefully placed, with the grass side uppermost, and the plants pressed well into the ground. No more turf should be cut, carried, and spread in any one day, than is likely to be planted before night. If the transplanted turf is found deficient in any particular species of favourite plants, as white clover, permanent red clover, &c. the seeds of those plants, should be sown upon the young pasture in April. When the ground is in proper temper, (between wet and dry), the pasture should be frequently well pressed down by heavy rollers, which will cause the plants to extend themselves along the ground, rather than rise into tufts, which otherwise they would be apt to do. No stock should be permitted to feed upon the transplanted pasture, in the first spring or summer, nor until the grasses have perfected and shed their seeds. Indeed the pasturing should be very moderate, until the mother grass-plants, and their young progeny, have united, and formed a compact turf. The expence of this operation is about 2*l.* 10*s.* per statute acre; without making any allowance, for the charges incurred by summer fallowing the arable land, on which the turf has been transplanted; nor for the year's rent, poor's rates, and taxes, for that year; nor for restoring the land, whence the turf plants were taken, to its previous state†.

This plan seems to be well calculated to promote the improvement of light soils, not naturally of a grassy nature, for the grasses and their roots, being once formed, on a rich soil, will probably thrive afterwards even on a poor one, as they will derive a considerable proportion of their nourishment from the atmosphere. For light and gravelly soils, therefore, where permanent pasture is desirable, the plan cannot be too strongly recommended; and if it were found to answer on peat, after the surface was pared for the reception of the plants, and burnt to promote their growth, it would be a most valuable acquisition to sheep farmers in many districts of the country.

* The grass of orchards would probably be well calculated for the purpose.

† See Mr. Blaikie's valuable tract, on the Conversion of Arable Land into Pasture, where the whole process is fully detailed. The tract likewise contains several useful hints on other rural subjects.

9. *Cultivated Grasses.*

The advantages which have been derived from the introduction of cultivated grasses, cannot be too highly appreciated. Amidst the variety of natural produce, there must be many plants of an inferior quality, which are rejected by horses, cattle, and sheep. Old turf, on that account, is seldom eaten so bare, as a field where a few selected plants alone are cultivated, known to be grateful, salubrious, and nourishing to stock. Natural meadow also, often contain plants with narcotic and poisonous qualities, by which cattle suffer much injury. Animals in a wild state, discover, by the smell, when plants are noxious; but stock, when domesticated, pay less attention to the information furnished by this sense; and they are often driven by hunger, to eat plants, which they would otherwise have rejected.

The cultivated grasses to be here treated of, are, 1. Red clover; 2. White clover; 3. Sainfoin; 4. Lucern; and, 5. Some miscellaneous articles, as yellow clover, rye-grass, &c.

1. *Red Clover.*—This variety of grass, is peculiarly profitable to the farmer, from the greatness of its produce, and the improvement which it occasions to the soil. Land exhausted by corn, and not accustomed to clover, is always restored to fertility, by the shade, smother, and putrefaction, arising from a weighty crop of this article*. It is more calculated, however, for strong soils, than for those which are loose and sandy. It will thrive on the former, even when not in a very fertile state, if sufficiently pulverized.

To insure a continuance of this fertility, in succeeding rotations, it is of great advantage, to give a deep ploughing to the summer fallow, or turnip crop that is taken, preparatory to the crop of clover, as has been proved in numerous instances†.

* Remark by John Middleton, Esq.

† Mr. Mason of Chilton, an eminent farmer in the county of Durham, entertains an idea, that clover has a tendency to promote mildew or rust in wheat. A field that had been partly oats, and partly clover, was sown with wheat: the crop was mildewed where the clover had been, but not where the oats had been grown. This is an additional circumstance, favourable to the idea, that land, for a crop of wheat, ought not to be in too rich a state. A farmer in the West of England, lately complained, that his rich crops were always mildewed, while his neighbours, whose land was full of couch, and out of condition, did not suffer from that malady. Hence it has grown into a maxim, "That the worst managers, get the best crops, once in seven years."

The cultivation of red clover, is too well known, to require being detailed in this place. The propriety of mixing other seeds with it, has been questioned; though some think the mixture of a small quantity of rye-grass, is of great advantage; more especially as that grass, being an early plant, serves as a nurse, or assistant, to protect the young clover from the severities of the season*. Rye-grass, *if cut young*, is not exhausting; it is rather of use in converting the clover into hay, and it improves the quality of the food, when cut for soiling, bringing it earlier forward†. This may render it more necessary in Scotland than in England. It likewise greatly improves the quality of the hay *for working horses*; rendering it more strengthening and substantial.

The most important particulars connected with the culture of red clover are, 1. The soiling process; 2. Converting it into hay; 3. Feeding it; and, 4. Retaining it in pasture.

Soiling.—By this term is meant, the feeding of stock in a house, shed, or fold, with cut green food, instead of making the grass into hay, or depasturing the field.

Various articles are used for that purpose in this country, as tares, lucern, and meadow-grass; also barley, rye, oats, and beans, all in a green state; but red clover, either alone, or mixt with rye-grass, is the substance most commonly applied‡.

Soiling is attended with the following advantages:—1. The saving of land;—2. Advantages to the fences;—3. The saving of food;—4. The improvement of stock;—5. The greater product of milk;—6. Increasing the quantity, and improving the quality of manure;—and, 7. Obtaining a higher value for the produce of the soil§.

In future, however, that slur, on good culture, may be prevented, by the diligent farmer, paying proper attention, to the diseases of grain, and the means of preventing them.

* Brown's Treatise on Rural Affairs, vol. ii. p. 157. The principal objections to rye-grass are, that it not only exhausts the soil, if suffered to seed, but makes the land too dry and solid.

† The quantity of clover-seed sown, is from 10 to 12 lbs. per statute acre, on dry friable soils; and from 14 to 18 lbs. on strong loams or clays, with one peck of perennial rye-grass.—*Northumberland Report*, p. 112.

‡ In America they likewise apply Indian corn, millet and buck-wheat, to the purposes of soiling.

§ In "*The American Farmer*," vol. ii. Nos. 23 and 24, there are some valuable remarks on soiling, communicated by the Hon. Josiah Quincy, which do great credit to that gentleman's knowledge of agriculture; and from which I have extracted several useful hints in the discussion of that subject.

1. *The Saving of Land.*—Exaggerated accounts have been given of the saving of land. Some have contended, that it is as one to seven, if not more.—By accurate experiments, it appears* that it may safely be stated as one to three, an advantage alone well entitled to the attention of the industrious and intelligent farmer.

2. *Advantages to the Fences.*—Where stock are stall-fed, fences are not so necessary, and in this way there may be a saving of land, and a diminution of expenditure.—But if the same fences were to be kept up, they are not so liable to injury from the stock maintained, nor from the carelessness of those who are employed to catch them.

3. *The Saving of Food.*—Animals destroy the grasses, destined for their food, when pasturing upon them, in six different ways:—1. By eating;—2. By treading;—3. By dunging;—4. By staling;—5. By lying down;—and, 6. By breathing on them.—Of these six, the first alone is useful.—All the others tend to waste, and that waste is always in proportion to the richness and productiveness of the soil.

4. *The Improvement of Stock.*—This advantage is applicable to all the different sorts of stock, more especially in dry seasons, when pastures are apt to fail.

Working horses, or oxen, derive great benefit from soiling. They are saved the trouble of collecting their food, after their work is over, and run no risk from noxious vegetables, or unwholesome water.—They can fill themselves much sooner, and consequently have more time for rest;—and they can take their repose much better, in a stable or shed, with plenty of litter, than in an open field, where there are so many things to annoy them.

The experiments of soiling cattle, have likewise been successful.—Young steers become more tractable for work; and are exempted from many accidents and disorders to which they are otherwise liable.—The size and the symmetry also, to which cattle may be brought, when thus kept constantly sheltered, in a progressive state of improvement, without receiving any check whatever, justifies the idea, that such stock will surpass those exposed to the vicissitudes

* It is singular, that an experiment was reported to the Board of Agriculture, of 33 head of cattle being soiled from the 20th of May to the 1st of October, 1815, on 17½ statute acres, in which it is stated, that it would have required 50 acres to have pastured them.—The result of Mr. Quincy's experiment, was nearly the same; for he kept the same amount of stock, by soiling them on 17 acres of land, which had always previously required 50 acres. It is a curious coincidence.

of climate, and other inconveniences inseparable from the grazing system, though pastured on fields of the richest and most luxuriant herbage*.

Sheep, also, thrive equally well when fed in houses, as when pastured out of doors, while their wool is much improved in quality, (not being exposed to the extremities of either heat or cold), and they escape several disorders, as the rot, &c. which are so often fatal.

Pigs may be soiled on clover, with much advantage, and for that purpose, there ought to be a patch of clover in the garden of every cottager. But green beans are perhaps a still more profitable article, as pigs are peculiarly fond of them. The Windsor sort are preferred, and the beans should be planted at different times, to insure a regular succession. Horses are also fond of green beans, after being a little accustomed to them; and stall-fed cattle, in general, thrive well on that food.

5. *The greater Product of Milk.*—It is highly expedient to soil milch cows, at least in the middle of the day, that they may not be tormented with flies in the field, nor induced to stand in brooks, or ponds of water, nor in the shade of spreading trees or hedges, by which much valuable manure is lost. The stock are thus kept in a healthier state, and the milk is of superior quality.—During the flush of the season, the quantity of milk may be as great from good pastures; but when they begin to fall off, cattle, regularly and abundantly fed in a house, must be greatly more productive for the purpose of the dairy.

6. *Increasing the Quantity, and improving the Quality of the Manure.*—This advantage cannot be controverted.—When land is pastured, the dung that falls upon it is destroyed in various ways, and does not go through the process of fermentation.—Whereas, by soiling, not only a greater quantity of rich dung is obtained, but it may be "*manufactured* to more advantage."—Besides, dung made in summer is always superior to that made in winter, for the warmth of the weather, promotes a rapid fermentation, and generates several valuable substances, the formation of which, the cold of winter, and the superfluous moisture of that season of the year, in a great measure prevents†. By this means also, clay-land farmers are, in respect of manure, put more on a footing with turnip soils.

7. *Increasing the Value of Land Produce.*—There is cer-

* Curwen's Report, p. 80. † Young's Calendar, p. 374.

tainly no mode, by which cultivated grasses will pay so well, as by soiling. In the neighbourhood of towns, the same land will produce at the rate of from 20*l.* to 25*l.* per statute acre, cut for soiling, which would be considered high at 9*l.* or 10*l.* if let in pasture. The expence of carting the cut grass, must, however, be deducted.

There are also, some other subordinate advantages attending the soiling system;—as the opportunity which it furnishes of using all the grass grown in plantations, or orchards, which often supply early food, before the first crop of clover is ready for cutting*. Cattle, and other stock, are also thus prevented from breaking fences, and getting into fields, where they often do material damage to corn, turnips, and other crops.—It is likewise attended with this advantage, in arable culture, that when clover is cut, the succeeding crop is uniformly better than when the field is pastured†;—and in regard to grass-lands, they are exempted from the mischievous effects of poaching in wet weather. Hence it is that sheep, are a preferable stock to cattle, unless where the soiling system is adopted.

In conducting the soiling process, the following rules are recommended:—To give food often, and in small quantities;—to attend to the manner in which the food is eaten by the cattle, reducing the quantity, on the slightest symptom of loss of appetite;—and to be cautious that clover is given sparingly, especially when it is wet, to prevent the cattle being hoven‡. This may be effectually avoided, if care be taken, to mow the clover two days in advance.—It is likewise advisable, (unless the cattle have been brought up from their infancy in houses), to give them the liberty of a yard, in which they may enjoy fresh air and exercise; and when they are fed in stalls, it is indispensably necessary, that they should be kept thoroughly clean, and frequently curried.

That the soiling system is attended with great labour, in cutting,—collecting,—and conveying the food,—in feeding, and keeping the stock clean,—in carrying the manure to the fields,—and also occasions some expence in buildings, cannot be denied; but surely these objections, are amply compensated by the advantages above detailed.—In all cases, therefore, where the soil and climate are favourable to

* Curwen's Report, p. 81.
† The authorities for this important fact, are stated in a Note to Sect. 4.
‡ Curwen's Report, p. 82.

the practice of soiling, there cannot be a doubt of its utility, and the propriety of its adoption*.

Making Clover into Hay.—This process is quite different from the plan of making hay from natural grasses. In all cases, clover ought to be mown *before the seed is formed;* and indeed before the plants have fully blossomed, that the full juice and nourishment of the clover, may be retained in the hay. By the adoption of this system, the hay is cut in a better season,—it can be more easily secured,—and it is much more valuable. Nor is the strength of the plant lodged in the seed, which is often lost.

The great advantage of converting under-ripe grass into hay, is now beginning to be known. There is much more saccharine matter in it, and it is consequently greatly more nutritious. The crop of clover, when cut in the early part of the season, may be ten per cent. lighter, than when it is fully ripe; but the loss is amply counterbalanced, by obtaining an earlier, a more valuable, and more nutritious article; while the next crop will proportionably be more heavy. The hay from old grass, will carry on stock, but it is only hay *from young grass,* that will fatten them.

After being cut, the clover should remain in the swath, till it is dried about two-thirds of its thickness. It is then, not *tedded* or strewed, but turned over, either by the hands, or the heads of hay-rakes. If turned over in the morning of a dry day, it may be cocked in the evening. The hay should be as little shaken or scattered about afterwards as possible; and if the weather be good, after remaining for some time, according to the season, in the cock, it may be carted into the stack†.

A crop of clover will yield from two to three ton of hay per statute acre. It sells, in the London market, for about 15*s.* per ton higher than meadow hay.

A new mode of making hay, originally tried in Lancashire, called "*gaiting,*" or "*tippling,*" (that is, tying

* In Flanders, they only sow *six pounds* of clover-seed to the English acre, *for a full soiling crop*; and the cost of the seed at market, is only sixpence per pound.—What an encouragement to cultivate a crop, which constitutes the ground-work of all good farming!—It is the cost of the seed, which deters the common farmer from having clover, and yet that seed is taxed on importation.—*Radcliff's Report of the Agriculture of Flanders,* p. 61.

† In dry climates, the practice varies: where the plant is not in a moist state, there is less risk of tedding it. In a good season, it may thus be got thoroughly dry in three or four days. It may be stacked without danger of over heating, on the fourth day; and will come out of the stack in perfect order.—*Communication from Mr. Holdich.*

up the grass in small bundles, as soon as it is cut), has been strongly recommended. When the weather is favourable, it may be stacked, by this process, on the fifth day. The expence of binding, and of setting up, costs only 2*s*. 6*d*. per acre; and a finer sample cannot be had from any stack of clover, than what it produces. The colour of the hay is beautifully green, and the smell most flagrant*.

Feeding.—With the exception of lucern, and the herbage of rich marshes, there is no crop, by which so much stock can be supported, as by clover. It may be profitably employed in fattening sheep in spring, and with this food, they will soon be ready for the butcher. Afterwards, a crop of hay may be got, and two or three weeks after the hay has been taken off, sheep intended to be fattened on turnips, may be turned in, and kept there, until the turnips are ready for them†.

On Tethering Stock.

Tethering‡.—In some districts of Scotland and Ireland, instead of soiling, they *tether* their stock upon the land.

In the Agricultural Report of Aberdeenshire, it is stated, that there are some cases, where the plan of tethering, can be practised with more profit than even soiling. In the neighbourhood of Peterhead, for instance, they tether milch-cows on their grass fields, in a regular and systematic method; moving each tether forward in a straight line, not above one foot at a time, so as to prevent the cows from treading on the grass that is to be eaten; care being always taken, to move the tether forward, like a person cutting clover with a scythe, from one end of the field to the other. In this way, a greater number of cows can be kept, on the same quantity of grass, than by any other plan; except where it grows

* It was introduced from Lancashire, into Scotland, and mentioned in the first edition of the Husbandry of Scotland, printed anno 1812. It has lately been tried by Mr. Curwen, with the greatest success. *Report*, p. 42. —It is highly desirable, to be peculiarly attentive to the process of hay-making, for an acre of well-cured hay, is more nutritious, than an acre of both straw and oats; and affords more manure to promote future fertility.

† Young's Calendar, p. 345.

‡ The most proper and effectual tethers are made of iron chains, the links short, and two swivels to each chain, to prevent them from twisting. Those for cattle should be five yards long, with a strong leather strap and buckle, to fasten to the fore leg of the animal, near the hoof: those for sheep, may be much lighter, and only three yards long, with belts to fasten round the neck. The tether is secured by a large iron pin, on the head of which, is a large swivel, which should play round the pin freely, otherwise the chain is apt to get entangled.—*Communication from Edward Burroughs, Esq.*

high enough to be cut, and given them green in houses. In one instance, the system was carried to great perfection, by a gentleman who kept a few sheep upon longer tethers, following the cows. Sometimes also, he tethered horses afterwards upon the same field, which prevented any possible waste, for the tufts of grass produced by the dung of one species of animal, will be eaten by those of another kind, without reluctance. This system was peculiarly calculated for the cow-feeders in Peterhead; as, from the smallness of their holdings, they could not afford to keep servants to cut, or horses to carry home the grass to their houses, to be consumed in a green state*.

In Ireland, the plan of tethering stock, is strongly recommended, in preference to that of promiscuous pasturage, even though accompanied by a herdsman, or keeper. It is there observed, that both cattle and sheep must thrive better, and feed faster, when they have a fresh bite of grass regularly given them, than when they are permitted to wander over a whole field. This is effectually done, when they are not allowed to range indiscriminately over pasture lands, destroying more than they consume, but when each animal is secured by a tether, to the spot on which he is allowed to feed. By changing this spot, he is enticed to eat, from having a clean and fresh bite, perhaps twice a day given him. He does not acquire rambling habits, which exhausts his strength, and prevents his fattening; but becoming docile, he necessarily thrives much better. The pasture also is improved, for the young grass is not bit off *prematurely*, which checks its progress, but remains untouched, till it is ready for consumption.

Some eminent and extensive agriculturists in Ireland†, have practised this system with success;—have produced by it, beef and mutton, of the best quality;—and their lands have been materially improved, since they followed that plan. In other cases, it has been tried with milch-cows; store cattle, sheep, and lambs; with all of whom it has completely answered‡; and by its adoption, it has been

* Observations by Dr. James Anderson.—See *Dr. Skene Keith's Report of Aberdeenshire*, p. 357, &c.

† Lord De Vesci has had beef of better quality, and fed in a shorter time, by this system, than by any other he ever tried;—and he is now improving some inferior land, on the principle of tethering.

‡ This practice is recommended as fit to be adopted in the following cases. 1. When grass-lands are not fenced off from the adjoining fields in tillage; 2. When there are young plantations in the neighbourhood of grass-lands, which cannot, without great expence, be secured from trespass;—

found, that land will improve more in two years, than under indiscriminate pasturage, in five; and, that at least, one-third more stock may be maintained per acre, under the one system than the other. The reason is obvious, the cattle being better fed, deposit more dung, which falling in a narrow compass, is trod into the ground, by the time the spot of grass, on which they are tethered, is nearly eaten; whereas, when dung is scattered about, the land is not much benefited by it*.

But though superior to promiscuous pasturage, the plan of tethering cannot, as a general practice, be compared to soiling. The latter is to be preferred, as securing a larger proportion of the crop of grass, of which some part must be injured or destroyed when stock are tethered on it;—as the grass, when cut for soiling, seems sooner to recover, and to grow up more quickly, and more equally, than what has been eaten off by the cattle;—as animals consuming grass in the house, are free from the excessive heat of summer, and from the stings of flies, which to them are extremely vexatious;—and as their dung and urine are of much greater value, when preserved in dung-hills or cisterns, and in a state fit to be carried wherever they are most wanted†, than even trod into the ground where dropt.

The plan of tethering, however, ought to be kept in view, *as an assistant to the soiling system;*—for where preparations have been made for soiling, and, owing to the coldness or dryness of the season, the clover has made little or no progress, so as to be unfit for cutting, it might be advisable, to try the plan of *tethering*, till the grass is more advanced.

Hurdling Off.—Where tethering is objected to, the plan of hurdling may be adopted, either with natural, or artificial grasses. By this mode of feeding, a portion of land in grass, is enclosed by hurdles‡, in which sheep are con-

3. When extensive fields are to be partly grazed; which cannot be so conveniently divided, so as to separate the grazing, from the arable land; and, 4. When the grass is too short to be cut.

* Communication from Edward Burroughs, Esq. Mr. Burroughs tethered seven sheep per acre in spring; and finding that there was better grass in the field in the middle of May, than when they were first turned on it, he was obliged to put two sheep more per acre to keep down the grass, in a state fit for that species of stock. In the Highlands of Scotland, they contend, that sheep, when tethered, fatten more rapidly than in any other manner.

† Agricultural Report of Aberdeenshire, by the Rev. Dr. Skene Keith, p. 356.

‡ Sometimes strong nets are made use of; but hurdles are preferable, unless the sheep are very tame.

fined; and as the crop is consumed, the pen is changed to a fresh place, until the whole is fed off. This practice is very extensively adopted at Holkham, and is peculiarly calculated for light and dry soils. Its advantages are, that the grass is more economically consumed;—that the stock thrive better, having daily a fresh bite;—and that the dung that falls, being more concentrated, is more likely to be of use*. An experienced farmer in Berkshire, (Mr. Stone of Basildon), consumes all his pastures, in portions divided by hurdles, *with store sheep*, (but not when fattening); by which, he estimates that the pasture will go twice as far. He even hurdles his wheat stubbles. In parks, or in the neighbourhood of woods, the sheep, when thus folded, may be littered in autumn, with the leaves of trees, and an addition thus made to the quantity of manure upon the farm. By this system, it it said, that lands in grass, will go twice as far, as when the stock are unrestricted, and can wander at large over the pasture.

Remaining in Pasture.—If the ground is to be pastured after the first year, it is necessary to sow a variety of grass-seeds with the clover. In Flanders, by means of the application of Dutch ashes, which destroys the vermin so injurious to the crops of the second year, and which often contain a portion of gypsum, the clover remains productive for two years; but as it fails the second year, under our management, it is necessary to supply the vacancy. If it were cut earlier the first year, the crop would be more abundant the next one.

The great object to be kept in view, is, to have a variety of grasses that will flourish at different seasons of the year. For that purpose, the late Mr. Bridge of Dorsetshire, recommended a mixture of from six to seven pounds of white clover, as much of marl-grass, the same quantity of hop-clover, and one bushel of the best Devonshire rye-grass. By this means, there is a succession of feed during the season. The hop-clover and rye-grass flourish early in spring; the marl-grass is in perfection in July, when the others go off; and the white clover is abundant in August, and continues during the remainder of the season†.

2. *White Clover.*—On rich dry soils, white clover *(trifolium repens)*, is strongly recommended, for bringing such lands into a state of sward; being accounted the best of all

* See Essays on Practical Husbandry, by Edward Burroughs, Esq. (a recent valuable publication), p. 7.

† Communications to the Board of Agriculture, vol. iii. p. 10.

pasture-grasses. It is a beneficial practice, to sow this species of clover with barley, and after pasturing the land for one year, to plough it up for wheat.

3. *Sainfoin.*—The improvement made by the culture of sainfoin, is very great. Poor soils, not worth more than from 2*s.* 6*d.* to 5*s.* per acre, for any other purpose, will, under this crop, yield from a ton and a half to two tons and a half of valuable hay, worth a guinea per ton more than meadow hay equally well cured; besides a considerable quantity of after-grass. It also lasts in the ground, equally productive, for a number of years.

It is unfortunate that so useful a plant, is not more extensively cultivated. The general idea is, that it will only succeed in chalky soils, or on lands resting on limestone; but it would probably thrive on other soils, if they were manured with a large quantity of calcareous matter; more especially on dry and shallow uplands, with a loose stony subsoil. The land ought to be in good order, thoroughly cleared of weeds before the seed is sown, and accompanied by barley or buck-wheat. An early seed-time ought to be preferred, as the end of February, or beginning of March; for, in dry weather, it does not vegetate. When in its infantine state, it is apt to be destroyed by the fly*.

Sainfoin is in general sown without being mixed with other grasses, though a small proportion of white clover, is considered to be rather beneficial than otherwise†. It may be disputed, whether sainfoin is equal to clover, on rich soils, but its great value is, that it produces an abundant crop, where clover will not succeed.

4. *Lucern.*—This valuable grass requires a dry and rich soil, which must be thoroughly cleansed, by two or three previous green crops of tares, turnips, or cabbages. It may be sown either broad-cast, which is the usual method, or drilled, nine inches apart, between rows of barley equally distant. It is better to sow it with barley, or oats, thinly seeded, both on account of the profit of the crop, and as the grain furnishes some protection to the plant from the attacks of the fly, which does great injury to it when very young. If drilled, from 12 lb. to 15 lb. of seed will do; if sown broad-cast, not less than 20 lb. It sometimes affords cutting four times a year, but will generally yield *three* good cuttings in the season. Lucern is much superior to clover for

* Young's Calendar, p. 106.
† Annals of Agriculture, vol. ii. p. 359.

soiling milch-cows, giving no taste to the milk or butter, and one acre is sufficient for three or four cows during the soiling season. In rich land, a quarter of an acre per head, will be sufficient for all sorts of large cattle, taken one with another, but on moderate soils, half an acre is the proper allowance. Lucern requires to be kept thoroughly clean, by hand-hoeing, and scarifying between the drills. All other grasses in the rows should be carefully plucked out*. If the third kind of land kept in permanent pasture, (the deep-soiled vale land), would answer for lucern, as there is every reason to believe it would, what a treasure there is at the command of the possessors of such soils? In proof of which, it is to be remarked, that in the island of Jersey, since the superior importance of lucern has been ascertained, grass land, of a good staple, has been often dedicated to the culture of that plant. It is trenched by the spade, which is an expensive process, but that is fully counterbalanced, by the certainty of success, the early maturity of the plant, and the employment which it would furnish to labourers†.

5. *Miscellaneous Articles.*—A variety of other grasses, in particular circumstances, might be grown with advantage. Trefoil, or yellow clover, (*medicago lupulina*), is an useful plant, mixed with other grasses, as it comes rapidly forward. Marl, or cow-grass (*trifolium medium*), being more lasting than common red clover, is well entitled to the attention of the farmer, when lands are to remain some time in a state of grass. In America, Timothy-grass, *(phleum pratense)*, is the principal growth of their meadow lands; succeeding well in moist soils and situations. It is very productive, and is coming gradually into use in England. It is rather a late grass, and its coarseness renders it at first objectionable; but the hay is abundant, and very nutritious. On mere bogs, the fiorin yields a great weight of herbage; and is perhaps the most useful plant that bogs can produce. The utility of rye-grass, *(lolium perenne)*, has been much disputed, but when stocked hard, and kept down,—or fed with sheep,—or, if intended for hay, cut early, the objections to it are removed‡. Cock's-foot (*dactylis glomerata)*, is early,

* Young's Calendar, p. 198, 255.

† Report of the Norman Islands, p. 113.—On the recommendation of the British Board of Agriculture, lucern has been introduced into our East Indian possessions; and potatoes are now more extensively cultivated there than formerly. Both are likely to prove most valuable productions in those countries.

‡ There is every reason to believe, that the common, or old rye-grass, is inferior to the new varieties.

hardy, and productive, but is a coarser plant than rye-grass, and requires even greater attention in regard to being cut soon, or fed close*. It does best by itself, and the time of its ripening, being different from that of clover, it does not suit well to be mixed with that plant. The pasturage it affords is luxuriant, and particularly agreeable to sheep†. Chicory also, is strongly recommended, as hardy;—calculated for the poorest soils;—and adapted even for bogs;—though not fitted to be converted into hay, yet excellent for pasture or soiling;—producing a greater quantity of food for sheep, than any other grass now in cultivation.

There are in all 215 *grasses*, properly so called, which are capable of being cultivated in the climate of Great Britain. Of these, only two have been employed to any extent in making artificial meadows,—rye-grass, and cock's-foot. The Duke of Bedford was thence induced to institute a series of experiments, to try the comparative merits and value of a number of other grasses, to the amount of 97, the result of which is annexed to Sir Humphry Davy's Lectures, and has since been separately published, with more full details.

According to these experiments, tall fescue grass *(festuca elatior)*, stands highest, as to the quantity of nutritive matter afforded by the whole crop, when cut at the time of flowering; and Timothy, or meadow cat's-tail grass, affords most food, when cut at the time the seed is ripe. Sea meadow-grass produces the greatest quantity of aftermath‡.

The paucity of cultivated grasses, has been a reproach to the agricultural enterprise of British farmers; but though the catalogue is extensive, the list of those *worth cultivating*, does not exceed from 10 to 12, and of these, some have seeds so small, and others so chaffy, that they can neither be dressed, nor easily sown. Some ripen very little seed, while others are but ill calculated for general soils and situations§.

* Cock's-foot is cultivated to a great extent, and with *astonishing success*, at Holkham. The quantity of sheep kept upon it, summer and winter, is *quite surprising;* and the land becomes *renovated* by laying two or three years under grass, and enriched by the manure derived from the sheep.—*Communication from Mr. Blaikie, at Holkham.*

† Curwen's Report, p. 42.—Cock's-foot does not suit low land, as in such situations, it is apt to grow too coarse. Mr. Falla strongly recommends the *festuca pratensis.*

‡ Sir H. Davy's Lectures, p. 315, and the Appendix, containing the result of the experiments instituted by the Duke of Bedford. See also the Memoir, in folio, printed by Mr. George Sinclair, gardener to the Duke of Bedford.

§ Mr. George Sinclair states it as the result of his experiments, that no grass is so well suited for all purposes as *cock's-foot.* A new variety of the

10. *Of Laying down Arable Land into Grass, for recruiting its Fertility, and on the Alternate, or Convertible Husbandry.*

It cannot be doubted, that if one-fourth part of the land, which at present is sown with corn, were properly laid down in grass, for the purpose of feeding stock, until it became again fit to bear abundant crops of grain, it would be of the greatest benefit both to the farmer, and to the public, as the other three-fourths would be better manured, more easily cultivated, and would produce as much for consumption, as the whole now does. The failure of new crops of grass, is in a great measure owing to a deficiency of seed, or to the land being sown, when out of condition, and without an adequate supply of manure; and great tracts have, in these circumstances, been continued under a course of aration, to the impoverishment of the occupiers, and the loss of the public*; whereas improved rotations, and in particular, a greater number of green crops, would enrich any poor, or exhausted arable land.

The laying down a portion of the arable land of the country into grass, is a subject of great importance, which may essentially contribute to prevent any apprehension of scarcity. Indeed nothing would give so much relief to any difficulty with respect to grain, as to increase the number of cows. Milk, used with rice, bread, biscuit, or with pot-barley boiled like rice, or meal or flour, would save a large proportion of the consumption of those articles. Nothing can be substituted so quickly, or so cheaply. Each cow, so used, would save one load of wheat per annum†.

Where the land is laid down to grass in good order, and is worth, in meadow, about 40*s*. per acre, it will keep a cow on two acres and a half. Each cow will give two gallons of milk per day, for twelve months out of thirteen, allowing

lolium perenne, (rye-grass) has been lately offered to the experimental farmer, by Mr. Holdich, under the name of "*Russell-Grass*," of which considerable expectations are formed.

* Communications to the Board of Agriculture, vol. iv. p. 203, and 210.

† Communications to the Board of Agriculture, vol. iv. p. 210.—Mr. Curwen thus estimates the profit derivable from milch cattle. On an average, each cow, of a good breed, and properly fed, will produce, 3739 quarts per annum, which, at 2*d*. per quart, is 30*l*. 3*s*. 2*d*. per cow. The feeding may cost 10*d*. per day, or 15*l*. 4*s*. 2*d*. per annum. The interest of capital, risk, insurance, may be stated, at 3*l*. Hence the clear profit from the cow alone, is above 12*l*. per annum, exclusive of the calf. Allowance is made, in this estimate, for the losses which must unavoidably happen.

one to be dry. Two gallons per day, at 8*d.* each, would produce 22*l.* 8*s.* per annum; but to prevent objections, let the amount be stated at 20*l.* per annum, the produce, being at the rate of 8*l.* per acre per annum, which is more than it would yield, if in an exhausted state, under corn, and at less expence. After recruiting its strength in this way, it may be again returned to arable culture.

But, in general, arable land is converted into pasture, for the purpose of feeding sheep. Various plans have been adopted for that purpose. In Rutlandshire, on dry loams, the following course has been adopted with success: 1. Turnips, or white pease; 2. Barley; 3. Clover; 4. Wheat; 5. Turnips; 6. Barley; and then grass for three or more years. Others recommend, as a more speedy and more profitable system; 1. Tares, and then turnips; 2. Wheat; 3. Clover; 4. Oats; and after a crop of tares and turnips, wheat with grass-seeds to continue. Such lands are, by these means, much recruited, and will, after a term of years, enrich the occupier, by the superior corn crops which five or six, or even three or four years of sheep-feeding, will enable them to produce*.

It is a great error, in laying down land to grass, to sow an insufficient quantity of small seeds. In general, 12 or 14 lbs. of clover is the usual average allowance. But that quantity, it is contended, ought greatly to be increased. In several instances, land has been laid down with ten pounds of red clover, ten of white, and ten of trefoil, or 30 lbs. in all, of small seeds, with the addition of three pecks of rye-grass, per statute acre, and the herbage proved most abundant†. This seems to confirm the doctrine already laid down, respecting the advantages of *a liberal allowance* of seed, when land is laid down to grass, more especially for any length of time. The plants, however abundant at first, will die off, to a proper standard, as they become older.

Another point to be strongly inculcated is, that land intended to be converted from tillage to grass land, must either be dry by nature, or be made so by art, before it is possible to get a valuable crop of artificial grasses; all the

* Communications to the Board of Agriculture, vol iii. p. 138.

† This observation is made by Mr. Wright, of Ranby, near Retford.—*Comm.* vol. iii. p. 505.—The crop of clover, however, often fails, not from deficiency of seed, but from defective cultivation, and want of management. The seeds should always be bush-harrowed, and rolled after being sown, according to the nature of the soil, and other circumstances.

best sorts abhor a wet bottom when they are young, and will not root deep enough in it, to bear the vicissitudes of the seasons; and not increasing by the roots as they ought to do, will die when they have perfected their seed, and leave the land bare*. In laying down arable land into grass, broad and high ridges have been likewise recommended. In this way the surface is indisputably enlarged.—Herbage, especially when it is pastured, spreads every way upon the ground, and does not rise perpendicularly, as corn. Besides, in this case, there is a variety of herbage, and a variety of soil, suited to every season. If the season be moist, the ridges afford plenty of sweet pasturage, and dry ground for the pasturing stock to rest upon; and in the dry year of 1783, it was remarked, that while the ridges, and flat lands in general, were burnt up with drought, the furrows of high lands continued in full herbage. It is observable, however, that in cases, where the subsoil is retentive, every furrow should have its under-drain, otherwise the herbage, especially in a wet season, will be of a very inferior quality†.

The advantages to be derived from the alternate, or convertible husbandry, cannot be too much dwelt on. None but those who have tried it, can be fully aware of the vast improvement effected, by laying down old ploughed land into grass, as well as converting pasture lands into arable. If one million of acres of old tillage land, were gradually laid down into herbage, and the like extent of old pasture broken up, and put under judicious rotations, it would probably be the means of supplying the public market, with not less than two millions of stones of beef and mutton, additional, and three millions of quarters of grain‡. Under that system also, when judiciously conducted, the crops are

* Davis of Longleat's Essay; Communications to the Board of Agriculture, vol. iii. p. 95.—In Norfolk, they have discovered a new mode of laying down arable land into grass, called "*Inoculating land for grass*," which has been already described, p. 483. By means of that discovery, it is said, that a good sward may be given to arable land in two years, which would not otherwise produce good pasture in the course of a number of years.

† Marshall's Gloucestershire, vol. i. p. 81.

‡ The convertible system of husbandry is much approved of in Northumberland. In light soils the rotation is, 1. Turnips, drilled. 2. Barley, or wheat, drilled. 3. Clover and grass-seeds, pastured, at first, partly with cattle, but principally with sheep, but afterwards pastured by sheep alone, for three or more years; then oats. On strong land, the same plan is pursued, substituting fallow or beans, instead of the turnip crop. Under this system, the land never refuses to produce abundant crops of all these several articles.

always abundant, and the soil is kept in a constant state of increasing fertility*.

At the same time, it is proper to remark, that too much pasture, in a populous country, ought to be avoided. It diminishes the necessaries of life, while it increases and cheapens the luxuries, and its produce is much less efficient, in furnishing subsistance to man †.

On the whole, it has been justly remarked, that the alternate system of husbandry, is the most beneficial to the cultivators and the public. A considerable capital is necessarily required, to commence, and carry it on; and it must occasion some trouble in its execution; but these are circumstances, which indispensably accompany every improved system. If one half of a farm be kept under artificial grasses, and other green crops, as much live stock may often be supported, and fattened upon their produce, as if the whole farm were pastured; while the other half, enriched by the large quantity of dung produced by the consumption of these crops, will furnish as much disposable produce, for supplying the market with the various sorts of grain, as if the whole farm had been sown with culmiferous crops. Hence the superior advantages, and profit derived, from a conjunction of stock, and of corn husbandry; by the union of which, wherever such a plan is practicable, British husbandry, can be more substantially improved, than by any other means that has hitherto been suggested‡.

* Brown's Treatise on Rural Affairs, vol. ii. p. 197.—Doctor Coventry supports these doctrines in the following terms:—The keeping of ground for too long a period, in a state of ley, or under grass, is an error arising from a predilection for grass-land, particularly if inclosed. In many parts of the country, this has given rise to a singular combination of profusion and remissness in the treatment of lands lying adjacent, and in every respect equally well adapted for regular and proper culture.—*Coventry's Discourses*, p. 16.

† It appears, from the most careful researches, that potatoes will produce, on an average, per statute acre, from 10 to 13 ton weight of food, fit for the human species. Wheat, after deducting seed, will produce, about 21½ bushels per acre, or 1240 lbs. in weight. Whereas, the quantity of animal food produced on an acre, when grazed, will only be about 180 lbs., and even under the dairy system, which is more productive, will rarely exceed 240 lbs.—See *Communications to the Board of Agriculture*, vol. vii. p. 47. The same weight of animal food, however, goes farther, than of vegetable, and it is raised at less expence.

‡ Brown's Treatise on Rural Affairs, vol. ii. p. 200. In England, unfortunately, the alternate system of husbandry, cannot be generally adopted, until the property of the landlord, is more distinctly protected from injury, either by an act of the legislature, or the decisions of the courts of law, enforcing covenants.

PART III.

OF GARDENS AND ORCHARDS.

GARDENING is the most productive and advantageous mode of occupying the surface of the soil. It also produces the most refined and luxurious articles of human food, and in some respects the most wholesome. Gardens, as shall afterwards be more fully explained, likewise employ, for their extent, the greatest number of labourers, and furnish the greatest quantity of useful produce, from the smallest space of ground. The greater the extent of land, therefore, thus cultivated, the more beneficial to the community. With gardens, orchards are frequently united; and their productions are often the same. The latter, however, will require a separate discussion.

I. *Of Gardens.*

In the garden, not only fruits of various descriptions, but also roots, salads, culinary vegetables*, and pulse, are raised, each of which has its respective advantages.

Fruits were probably the first substances to which men directed their attention, with a view to aliment, though they have now become, rather an article of luxury, than of substantial diet. They are produced by nature, in that season of the year, when such substances, with their cooling, refreshing, and diluting qualities, are peculiarly acceptable.

Roots contain a greater proportion of nourishing matter, though in that respect they are inferior to grain. There are

* In Scotland, these are called *pot-herbs*, or vegetables fit for culinary purposes, and that boil soft; but in England, by that word is meant, (at least by gardeners), thyme, sage, mint, and other articles of a similar nature.

above forty different kinds produced in this country; but the potatoe, and the turnip, are the only sorts very extensively cultivated. By using these, less bread and animal food is rendered necessary, and if taken in sufficient quantities, the human frame can be supported by them alone, more especially in youth, or when severe labour is avoided*.

Salads have been considered rather as an article of luxury than of aliment. Some of them, as the lettuce, are valuable for their cooling qualities; but, from their narcotic qualities, several of them cannot be eaten with safety, unless they are blanched†.

Cabbage, cauliflower, and other culinary vegetables, in their natural state, are but little calculated for human food. They are hard and difficult of digestion; and can scarcely be too much softened in their texture, to render them fit for the stomach. They are of considerable use, however, to counteract the putrescency of animal food, being of a watery, and somewhat sourish or acescent nature. Being laxative, they are useful in summer, to relieve the bowels, when costiveness takes place, which often happens in that season of the year, from the increased discharge by the skin.

A portion of garden ground is also employed in raising pulse, in particular, beans and pease, with a view of procuring the more delicate sorts, and much earlier in the season, than could be expected from field culture. The consumption of pulse, however, as human aliment, is necessarily circumscribed. In their earlier state, as green, succulent food, they are generally acceptable; and when they have reached even maturity, they may be used in soups; but if ground into meal, when all their parts have come to maturity, they are only calculated for those who have strong powers of digestion‡. Many of these vegetables are of immense importance, as a resource in times of scarcity, since two or three crops of them might be obtained, while we are waiting for those of grain.

* The lower orders of the Irish, who are a strong and handsome race of people, live almost entirely upon potatoes, with the addition of buttermilk. The ancient Romans lived much upon turnips.

† This is done by tying them up, by which their colour is improved;—any acrimonious bitterness in the plant is prevented;—and they are rendered tenderer for eating.

‡ Perhaps the proper *boiling* pea may be an exception.

After these general remarks, we shall proceed to consider, 1. The advantages of gardens in general; 2. The different sorts; 3. The rent of gardens; and, 4. The means of their improvement.

1. *Advantages of Gardens in general.*

These are evident, from the great number of individuals they employ, and the immense quantity of valuable produce thereby raised.

The quantity of productive labour, depending upon the gardens in the neighbourhood of London, is particularly great. The digging, hoeing, trenching, harrowing, planting, grafting, pruning, budding, gathering, and marketing the fruit, and other productions of the garden, together with the carriage. and the great number of dealers, who either sell the articles at the market, or cry them about the numerous streets of the metropolis, and adjoining villages, must furnish a very great quantity of labour and profit to numerous individuals*.

There are said to be 14,000 acres occupied as fruit and kitchen gardens, for the supply of London with fruit and vegetables†; the average produce of which, even at the present reduced price of the various articles brought to market‡, may be stated at the rate of about 60*l.* per acre, or 840,000*l.* per annum. This places the gardener's art in the most favourable point of view, as no other application of land, nor of rural labour, can supply so great a proportion of human food,—or yield so much employment to the cultivators,—or pay so liberally for the labour bestowed on it§.

In the immediate vicinity of Edinburgh, there are about 500 statute (400 Scotch) acres, employed in gardens, besides those at from six to fifteen miles distance, which occa-

* Middlesex Report, p. 265.

† It is incredible how much the middling and lower orders live upon vegetables, in the summer and autumn. In these seasons, it is supposed that the gardens feed more people than the fields.—*Lysons' Environs of London*, vol. i. p. 28.

‡ The reduction is from one-third to two-fifths of the value of the average produce, with very little diminution of the running and unavoidable expences.

§ Middlesex Report, p. 267. The profits of the dealers are not included in this calculation.

sionally send supplies to the market. The total produce is stated at 18,000*l.* in all, or 36*l.* per statute acre, per annum*. This is considerably less than the average produce of the gardens near London; but the latter are situated in a better climate,—a large proportion of them employed in the production of luxurious articles;—and they are close to a superior market, where higher prices are obtained;—where greater quantities of suitable manure can be readily procured;—and where more labour can be bestowed with advantage.

In the neighbourhood of Aberdeen, the market gardeners find onions the most profitable article they can raise, procuring from 45*l.* to 58*l.* per acre, according to the price the article sells for†. Carrots yield about half these sums. Turnips from 14*l.* to 18*l.*; and potatoes, from 15*l.* to 20*l.* according to the crop and season‡.

On the whole, there can be no doubt, that from their higher cultivation, and, (unless under very peculiar circumstances), their greater fertility;—from the higher value of the articles produced, in consequence of either their superior quality, or earlier growth;—and from more than one crop being generally raised in the same year, on the same ground, the produce of the garden must be more valuable, than that from arable or pasture land.

From the superior quantity and value of garden-produce, it might be supposed, that a larger proportion of the country would be cultivated in that style. But the expences are so great, that if the price of the articles sold were much reduced, (which would be the necessary consequence of a more extended culture), gardening would be no longer followed as a lucrative profession. Competition has probably already gone as far as it ought; and the consumption of fruits and vegetables in London, comparatively speaking, already far exceeds that of any other part of the kingdom. It is at the rate of 16*s.* 9*d.* per head, while that of Edin-

* Mr. Neill's Chapter on Gardens, General Report of Scotland, vol. ii. p. 85. The produce is about 45*l.* per Scotch acre. Even strawberries do not yield more than 40*l.* to 50*l.*—*Ditto*, p. 90.

† An experiment was tried, what quantity of onions could be produced by dint of manure, and on a quarter of an acre, three tons, gross weight, were raised; which sold for 24*l.* and left a profit of 13*l.* after paying the expences, which amounted to 11*l.*—The seed was originally from the white Lisbon onion, naturalized to the soil.—*Communication from the Rev. Robert Hoblyn.*

‡ Aberdeenshire Report, p. 364.

burgh does not exceed 3*s.* 6*d.* estimating its inhabitants at 103,000, and the fruit and vegetables sold at 18,000*l.* per annum.

2. *The different Sorts of Gardens.*

These may be classed under the following heads: private fruit-gardens;—private kitchen-gardens;—market-gardens, either for fruit or vegetables, cultivated by the spade;—field-gardens, chiefly cultivated by the plough;—cottage-gardens;—and village-gardens.

1. *Private Fruit-Gardens.*—It is fortunate, that a taste for the cultivation of fruit, often prevails among the rich. It affords a pure, rational, aud pleasing amusement; and furnishes inducements to those, who are possessed of landed property, to reside on their estates, and to abridge the time, which otherwise they might be induced to spend in crowded cities.

Fruit-gardens may be divided into two classes: those where fruits are cultivated, which require hot-houses to bring them to perfection; and such as raise fruit capable of being brought to perfection, under judicious management, by the ordinary temperature of the climate*. In numerous cases, however, both kinds are united.

The pains taken, and the expence bestowed, in raising fruit by artificial means, in England and Scotland, are very great, and must necessarily increase, in the more northern districts, in proportion as the climate is more severe†. In the construction of *hot-houses*, some improvements have recently been made. It is found a saving of expence, to have the sashes fixed, instead of sliding up and down, which occasions the breakage of glass; air being admitted at the bottom, by ventilators in front, and likewise at the top of the back wall.—*Standing-flues* within the house, are also found greatly preferable to the old practice of having the back walls of hot-houses flued like hot walls; and those

* This depends much upon the soil. Mr. Middleton observes, that the best soil for a fruit-garden, is a free marl (malm). This soil prevails at Brentford and Isleworth, in Middlesex, and advantage has been taken of that circumstance, to build numerous walls, ten feet high, from the produce of which, the fruit shops in London are supplied with the very best apricots, peaches, nectarines, and even pears.—*Communication from John Middleton, Esq.*

† It is calculated, that for the protection of exotic fruits, 479,360 square feet of glass are employed in Scotland alone.—*General Report of Scotland*, vol. ii. p. 121.

flues should be made wider or broader than usual, but not deeper. When flues are of small dimensions, there is not capacity in them for allowing the heated particles of air to expand; and a large proportion of the heat, therefore, escapes with the smoke, in a latent state, which is obviated by the greater width. In small hot-houses, where economy is studied, the best kind of flue is made of earthen-ware, the same as used for pots to the tops of chimnies, only somewhat thicker. The pieces are two feet and a half long, and about ten inches in diameter, inside measure. They are laid end to end, and every joint rests upon bricks, with a semicircular hollow made on purpose. Such flues are cheap, and require much less fuel than brick ones.

It may be proper to add, that cast-iron is a very advantageous substitute for wood in hot-houses. It is incomparably more lasting;—its appearance is more light and elegant; and by the proper disposition of columns and screws, rafters are saved, and expence lessened, while all the requisite strength is preserved*.

The heating of walls by flues, is another mode of employing artificial warmth for the production of fruit. Without the aid of this contrivance, peaches and nectarines could very seldom be brought to perfection, in the open air, in such a climate as that of Scotland. They are frequently so constructed, that a temporary glass frame can be raised against them; and they are generally furnished, with an apparatus for temporary covers, either of nets, or canvass, or of worsted.

Various devices are resorted to, for protecting the blossom of the more delicate and early-flowering fruit-trees on the open wall, from the effects of the frosty winds, which often prevail in March, April, and May; but nets made of coarse woollen yarn, with the meshes only large enough, when stretched out, to admit the point of the finger, are preferred†.

The advantages attending the pruning of fruit-trees are well known. It tends to diminish over-luxuriance, which

* General Report of Scotland, vol. ii. p. 131; and Appendix, vol. iv. p. 452, where there are some additional hints for improvements of a more minute description.

† Mr. Middleton states, that some of the fruit-growers of Brentford, Middlesex, protect the blossoms and fruit till out of danger, by a deal or other board, ten or twelve inches in width, placed horizontally upon brackets, near the top of their fruit-walls; and these are said to afford considerable security to their fruits, (which are supposed to be the finest in Britain), against frost, &c.—*Communication from John Middleton, Esq.*

retards fructification; and by it free access is given to the air, and to light, which promote the ripening, and augments the flavour of the fruit. The proper time for subjecting trees to this operation, is, when the sap has ascended, which is generally early in spring, and when the leaves have fully expanded*.

Peeling the outer bark of fruit-trees, is an ancient practice†, to which the attention of the public has lately been called, by the successful experiments made, on a great scale in the neighbourhood of Edinburgh‡. Three useful purposes are answered by this operation: 1. The stricture of the bark, or its being hide-bound, which frequently impedes the circulation of the sap, is removed. 2. A number of insects, and their larvæ, which have been deposited in the bark, are destroyed, and the young leaves and blossoms are protected from their attacks. And, 3. The air has admission to the trunk, by which it is nourished. It is not, however, advisable, to take off the bark of young trees, or of new branches of old ones, or by any means to destroy or even to injure the inner bark. When done to old trees, with judgment, they throw out healthy bearing wood, more especially when the bark has been cracked or diseased, or become a shelter for insects.

The same plan has been tried on vines, with great success; and it may prove a practice highly advantageous to the extensive vineyards on the Continent. It must be done, however, judiciously, both with vines and fruit-trees, for the inner bark must be carefully preserved.

* See White's Canada, p. 128.

† "If the trees have their bark base, you must, with a bill, *take away the old bark to the quick;* for the trees being thus discharged, do shoot forth with new strength," &c. Le Gendre, Curate of Hunonville, translated and printed at London, an. 1666, a small octavo volume, p. 136.—In Hitt's Treatise on Fruit-Trees, printed an. 1756, 8vo. p. 122, it is said, "For those trees that are not dressed at all, *taking off the old rind*, and cleansing the cankered parts, destroys many insects and their eggs."—In Rivington's Annual Register, for 1726, title "Useful Projects," p. 109, we are told, that it is customary in Connecticut, to strip off the bark of old decayed apple-trees, taking care not to injure the inner bark, to renovate the trees. In M'Phail's Gardener's Remembrancer, p. 28 and 29, notice is taken, of experiments made at Kensington Gardens, an. 1802, of peeling or cutting off the *outer bark*, without damaging the *inner bark*. Also, in p. 119, the peeling off the loose bark of the vine, and washing the plant with water and soap, with a sponge, is recommended.

‡ Mr. P. Lyon of Comely Garden, near Edinburgh, has tried the experiment on above 800 fruit trees, both young and old, and with great success. T. A. Knight, Esq. recommends, in the case of old trees, after taking off the old bark, to graft, on the old stump, new varieties. This hint may be of the greatest service in decayed orchards.

In many cases, particularly in pear-trees, cutting out a narrow ring of bark, from one-half to one-third of an inch, quite round the stem, has rendered the crop abundant, which otherwise would have failed*. If the incision be covered with a rag, the hollow will be filled up with new bark in the space of a few weeks.

In many cases, fruit-trees are at first planted too deep in the soil. The roots are thus excluded, by a superabundant load of earth, from the beneficial influence of the atmosphere. By a removal of part of the useless covering, leaving only a few inches of loose earth over the roots, vigour has often been restored to the tree.

It is proper to add, that taking off the earth, in a circle of three feet in semi-diameter, round a fruit-tree, throwing in two or three pailfuls of soap-suds, that have been used in washing, and then replacing the earth, has a most beneficial effect, in rendering every species of fruit-tree productive.

The same system may be successfully applied to currant, gooseberry, and raspberry bushes; and to vines, merely throwing the soap-suds on the ground where they grow, has been found of use.

2. *Private Kitchen-Gardens.*—To those who reside in the country, a well cultivated kitchen-garden is a most essential object, with a view to health, comfort, and economy.

It requires attention to the following particulars: 1. Soil; 2. Trenching; 3. Manures; 4. Vermin; 5. Rotations; and, 6. Articles to be raised.

1. It is found that a sandy loam, is peculiarly adapted for a kitchen-garden, more especially when the grains of sand, of which the soil is composed, are small, as by that means the soil is capable of retaining a greater quantity of manure, and of moisture, in dry seasons. A free marl, or a soil with a good mixture of clay, so favourable to retention of these articles, will likewise be found well calculated for garden culture. The addition of a moderate quantity of oxide of iron, is of much use in promoting fertility†. It is fortunate, however, when a garden contains a variety of soils: as some

* Lancashire Report, p. 83; Derbyshire Report, vol. ii. p. 215.—In May 1808, Mr. Shephard's bailiff, cut out a ring of bark, between two and three inches broad, and the full depth of the bark, from a very old pear tree, that had never borne fruit, and the consequence was an abundant crop.—*Buckinghamshire Report*, p. 252.

† Bedfordshire Report, p. 156.

vegetables require a strong and heavy soil, and do not thrive in a light one. Where the subsoil is wet, draining is indispensable.

2. Preparing the soil, and trenching it to the proper depth, is not always sufficiently attended to in garden culture. The soil ought to be from one foot and a half, to two feet and a half deep, particularly where tap-rooted vegetables are cultivated. The roots can thus, with greater facility, extend their fibres, in all directions, in search of vegetable nourishment, and a reservoir is provided, for any superabundant moisture, which may be occasioned by heavy rains, where it is retained till wanted.

3. The species of manure must depend upon the soil. Rotten dung is preferred by gardeners, as, in the course of fermentation, the seeds of weeds, and the larvæ of insects are destroyed; and the more putrid the dung, the greater effect it has in promoting the rapid growth of the plant*. Sea-weed, where it can be procured, is an excellent manure for garden crops, in particular for onions†. Soapers' waste used in moderation by itself, or in a compost with earth, is an excellent manure for garden soils. This substance, not only destroys insects and their larvæ‡, but, consisting prin-

* It is much disputed, whether rich and putrid dung is of use to vegetables. Some contend, that all vegetable produce is sweeter, and more delicate, in proportion to the quickness of its growth, and that none have so ill a flavour, as those on poor soils, ill manured, that will not advance them sufficiently quick. It is the quick-formed juice that is the sweetest: and thence, it is contended, that the rankest and most putrescent manures, give the finest taste, because they make the plants shoot away with the greatest celerity. *Young's Annals of Agriculture*, vol. xxxix. p. 303.—These doctrines are supported, by the high repute in which the unusually large and luxuriant vegetables are held, which are grown at Mr. John Gratian's garden at Belper, by the aid of liquid night-soil, and sewer-water, applied in the way of irrigation. *Derbyshire Report*, vol. ii. p. 209.—On the other hand, it is maintained, that vegetables raised by abundant fetid manure, can never be so well tasted, nor so wholesome;—that London brocoli, for instance, has a strong, and most disgusting flavour;—and that a turnip from a common tillage field, is much superior to what can be obtained from a rich garden. On the whole, it would appear, that when a large portion of dung is used, the vegetable is forced so rapidly, that it is insipid, or deficient in flavour,—that a moderate quantity of dung, produces plants of a better quality,—but that vegetables, grown luxuriantly in a fresh maiden earth, are the sweetest. In such soils, the leaves of the brassica, or cabbage tribe, are sometimes so superior in quality, as to be nearly transparent.

† General Report of Scotland, vol. ii. p. 94. When sea-weed could be had at Kirkcaldy, at a reasonable rate, the crops of onions were remarkable for their produce. Sometimes from eight to twelve pecks were got per fall, and sold for 4*s.* per peck. *Ditto.*—Onions thrive well when transplanted.—*Derbyshire Report*, vol. ii. p. 212.

‡ Soapers' waste is found to check, and to destroy the club or *bodge*, so destructive to the growth of the *brassica*, or cabbage tribe. This disease is

cipally of calcareous matter, every species of vegetables are greatly improved in quality, where it is applied. Cow-dung, mixed with water, is a good manure, when frequently applied in a liquid state. In Flanders, they use no other dung but that of the cow, for peaches, the dung of hogs and horses being of too burning a quality*. The best manure for apple trees, is said to be tanners' bark. A tanner's orchard rarely fails. In the rich garden-ground, in the neighbourhood of London, the application of stone lime in powder would be of singular utility.

4. Slugs and snails are very destructive in a garden. Slacked lime, sifted coal-ashes, saw-dust, or the awns of barley, spread on the surface, or laid in rows, in various places, are useful in destroying them. Salt would probably be still more effectual.

5. Skilful gardeners recommend attention to a rotation of crops, and occasionally fallow portions of their gardens, or lay them down with clover, which seldom fails to restore them to their former fertility. The most experienced horticulturists are now agreed, that even the currant, gooseberry, and raspberry quarters, should be changed every seven or eight years, and the strawberry ground every four or five years. The chief market-gardeners near Edinburgh, think it essential to adopt a certain rotation of principal crops, to be afterwards stated.

6. With respect to the articles cultivated in kitchen-gardens, there are above eighty different sorts, raised even in Scotland, notwithstanding its inferiority of climate; the mere enumeration of which, with some remarks on their nature and quality, and mode of culture, would fill several pages, and must therefore be omitted in so limited a work as this†.

3. *Market-Gardens cultivated by the Spade.*—The market-gardens in the neighbourhood of London, from the amount and value of their produce, are entitled to peculiar attention. Owing to the natural richness of the soil;—the quantity of manure given them;—the labour bestowed in their cultivation;—and the skill with which they are managed, the produce of those in the immediate vicinity of the metropolis,

occasioned by a hard maggot perforating, and depositing itself, in the stem part of the root, by which the juices, intended for the growth of the upper part, are prevented from ascending, and are converted into a hard substance beneath the surface, which sometimes weighs a pound or more. Soapers' waste might prevent a disease of a similar nature, to which turnips are liable.

* Vanderstraeten's Improved Husbandry, p. 162.

† See this subject very ably treated of in the Chapter on Gardens, by Mr. P. Neill; General Report of Scotland, vol. ii. p. 105.

is estimated at from 100*l.* to 200*l.* per acre, per annum. As such produce is so unusually large, it may be proper to explain whence it arises.

The gardens situated at the Neat Houses, near Chelsea, in Middlesex, are distinguished for their produce and value; but they have many advantages in their favour. The soil is naturally fertile;—for a great length of time it has been cultivated for kitchen-gardens, and abundantly supplied with dung;—by attention to the sluices, the occupiers can have the command of water;—and being situated in the immediate vicinity of the metropolis, the expence of conveyance is moderate*.

But the place, where the greatest quantity, and value of produce, is raised from the smallest extent of land, is in the neighbourhood of Blue-anchor-lane, Bermondsey, Surrey. That is effected, by covering from a third, to a fourth part of each garden, with hand-glasses and frames, the former, to assist in forwarding the growth of the articles planted; and the latter, to preserve, during the winter season, such plants as are to be placed out in the spring, to succeed the former. Gardens managed at such expence, may well produce to the great amount of even *two hundred pounds per acre, per annum.* But when the subjoined statement of the expences attending the culture, is considered, even that produce does not furnish more than an adequate remuneration, for the outlay of capital, and the unceasing fatigue and anxiety of mind attending such a troublesome concern.

Expence of cultivating ten acres of garden ground, where a considerable proportion of the soil, is covered with hand-glasses and frames.

Rent of ten acres, at 10*l.* per acre, per annum,	£100	0	0
Poor-rates, tithes, and other taxes, at 8*l.* per acre,	80	0	0
Ten women, on an average, 52*l.* per annum each,	520	0	0
Four women, at 20*l.* each	80	0	0
Five horses, at 52*l.* per annum,	260	0	0
Two carters, at 50*l.* per annum,	100	0	0
Manure, seeds, and water,	200	0	0
Baskets, tools, &c.	100	0	0
Market expences,	50	0	0
Blacksmith's, wheeler's, and carpenter's bills,	100	0	0
	£1590	0	0
Interest of capital, and profit,	410	0	0
	£2000	0	0

* Middlesex Report, p. 330.

The produce must be immense, and the prices high, to compensate for such heavy charges, as must be incurred in such cases, where 3000 hand-glasses* are employed, and 60 frames, for securing an early produce.

In market-gardens, where cultivation is carried to the greatest perfection, cauliflowers and cucumbers are raised *under glasses*, and yield large sums. Cauliflowers, when grown early in spring, in a good season, will yield at the rate of 80*l.* per acre; and cucumbers, when the crop is abundant, and when they are brought to market in warm weather (which greatly promotes their consumption), will fetch from 100*l.* to 120*l.* per acre. Between the glasses, there is generally an inter-crop of celery†, which in many cases is continued in the same soil for years. A variety of other articles are likewise raised, as radishes, lettuce, beet, onions, spinnage, brocoli, coleworts, or cabbages, either in succession, or intermixed with each other, according to the judgment of the gardener.

Among the crops produced by market-gardeners, that of asparagus merits particular attention. The general average value of its produce may be stated at from 50*l.* to 75*l.* per acre, per annum; but that is the only crop that the soil yields during the season, and it is attended with considerable labour and charges, in the gathering and preparing it for market. The original expence, in laying down an acre of asparagus in a proper manner, cannot be stated at less than 105*l.* to which ought to be added, the rent of the land, before it makes any return. It may remain productive for ten years, but 10*l.* per annum may be stated for the expence of labour, and as much for collecting the article, and sending it to market, besides rent, taxes, interest of capital, &c.

The average produce of market-gardens, of the first and second quality, may be calculated at 150*l.* per acre, per annum; while the average expences, and probable profit, may be stated as follows:

* The expence of glass used in artificial gardening, to force an earlier production, is very considerable. They are of two sorts, hand-glasses, and globe-glasses. The former cost 5*s.* each, the latter 8*s.* But these are not now to be purchased, except at sales, even at that price. If bought new, they would cost from 10*s.* to 12*s.* each, in proportion to their weight, according to which the duty is levied.

† From 200 to 300 acres of celery may be annually grown in the neighbourhood of the metropolis, to be consumed as a salad, to flavour soups, &c. Celery is considered to be a powerful antiscorbutic.

	Per Acre.		
Rent, tithes, and taxes,	£20	0	0
Labour,	50	0	0
Teams and manure,	40	0	0
Marketing, and other expences,	10	0	0
	£120	0	0
Profit, including interest of capital, &c.	30	0	0
Total,	£150	0	0

There are many market-gardens, however, in the neighbourhood of London, of an inferior quality, the produce of which, though cultivated by the spade, does not exceed in value above 90*l.* per acre, and some very inferior soils, not above 50*l.* The returns, indeed, are extremely fluctuating: some crops may afford large profits one year, from the growth of which, next year, loss may be incurred. The expences are always great, and there are few pursuits, where, considering the skill and industry applied, less profit is in general made, than by the market-gardener.

In various parts of England and Scotland, market-gardens are to be met with, but greatly inferior, in respect of produce and value, to those above described. It requires great industry, and severe labour, to derive much profit from such occupations, where the rents are high; yet many families do subsist, by cultivating from two to ten, and sometimes sixteen acres each, as garden-ground. This is accomplished, by a regular succession of crops in the same year, of which the following examples, as practised in the neighbourhood of Edinburgh, may be adduced.

1*st Rotation.*—Early potatoes, planted in March or April, the ground cleared in June or July, and sown with yellow turnip and cauliflower, or green savoys.

2*d Rotation.*—Early pease, sown in December, January, February, or March. Green savoys and German greens, sown between the rows of pease in spring, to remain for crop, after the haum of the pease has been cleared off the ground.

3*d Rotation.*—Early turnips, sown in March or April; the ground cleared in June or July, well manured, and sown with onions, spinnage, and lettuce, for winter and spring use*.

* General Report of Scotland, vol. ii. p. 90.

The average produce of land, cultivated under these rotations, will be at the rate of from 40*l.* to 45*l.* per acre. The expence of manure and labour is very great, and without unremitting attention and industry, the market-gardener could not make money*.

4. *Field Gardens cultivated by the Plough.*—Some gardeners occupy a large extent of land, and using agricultural implements, are distinguished by the name of "*Farming Gardeners.*" There are not less than 8000 acres in all, in the neighbourhood of London, cultivated by such gardeners, and principally by the plough, instead of the spade†. Their crops commonly are, 1. Early pease, sown in January or February, the price and produce of which vary, but the average may be stated at 40 sacks (four bushels each, in their pods), at 7*s.* 6*d.* per sack, or about 15*l.* The haum of these early pease, is nearly equal to hay, and may be moderately stated at 3*l.*; hence that crop produces 18*l.* in all. 2. The ground is cleared from the pease in June or July, and sown with turnips, which produce above 20*l.* per acre, when sold in the markets of the metropolis for immediate consumption. 3. When the turnips are sold off, the ground is again ploughed, and planted with collards, or coleworts. If the pease are late, they are generally succeeded by a crop of savoys, or of late cabbages. The average produce of land cultivated in this manner, may be stated at 50*l.* per annum.

The rent of land thus cultivated, does not in general exceed from 3*l.* to 5*l.* per acre; for though the expence of labour is cheaper, yet the articles raised by plough culture, are generally large, as cabbages, carrots, turnips, potatoes, coleworts, savoys, &c. and being of great weight, are expensive to convey. Articles of common produce also, will not command such prices as the finer sorts, consequently

* Near Devizes, and other towns in Wiltshire, many families subsist by occupying from two to five acres each, as garden ground. The soil is sandy, and applied to the produce of esculent vegetables, for the consumption of the neighbouring towns and villages. *Wilts Report*, p. 82.—So productive are gardens, when well managed, that three brothers, who followed the art of gardening, supported as many families, very decently, and gradually acquired some wealth, by the cultivation of about five acres of land.—*Berks Report*, p. 301.

† The Rev. Mr. Hoblyn thinks, that gardens in the country, are more advantageously cultivated *by the plough* than the spade, for as much work is done in a day by the one power, as in a month by the other. In his own garden, the first ploughing is carried to the depth of nine inches, the second in the same furrow to six more, the whole depth fifteen inches. Having a command of space, the ground was only cropped once a year, and by this means, it was kept clean and in good condition.

the returns are not in proportion to the difference of expence, between plough and spade culture*.

Sometimes farming gardeners, raise not only vegetables, but grain and grass, in which case, after a crop of early potatoes, and then turnips in the same year, wheat is sown with clover. This is considered to be the most profitable plan that can be pursued by farming gardeners, from the saving in the expence of labour. Where manure cannot be had without difficulty, to carry on a succession of vegetable crops, oats, barley, or green tares, is occasionally taken after the clover, thus refreshing the land, with crops of a varied description.

5. *Farmers' Gardens.*—A garden, under a proper system, is a most valuable acquisition to a farmer, with a view both to comfort and economy. Many culinary articles may be obtained, from a well-cultivated and sheltered garden, which cannot be raised in the field, or will not grow in exposed situations, with equal luxuriance and perfection. Attention likewise should be paid, to the sowing of different articles at various seasons, by which an earlier and a more equal, as well as more regular supply for the table may be obtained. It is also of use, to employ a piece of ground in a garden, for raising cabbages, Swedish turnips, and other plants, to be afterwards transplanted into the fields. The refuse of the garden, may be given with advantage to pigs, and milch cows. At the same time, working in the garden, should always be considered as of inferior consideration to the business of the farm†; and on no account ought the farmer's attention, to be materially drawn off, from his crops of grain and grass‡.

The size of the garden ought to depend, not on the extent of the farm, but the number of the family, and on the mode of cultivation, whether by the spade or the plough. In general, from one half, to about three-fourths of an acre, is sufficient, when cultivated by the spade, including a portion kept in grass, in rotation, for the drying of clothes, whether spread on the grass, or hung on lines.

If the ground is cultivated by the plough, according to

* Trench ploughing, for garden farming, costs from 30*s.* to 50*s.* per acre; whereas digging and trenching, with the spade, costs from 50*s.* to 4*l.* per acre; and deep trenching with the spade, from 4*l.* to 6*l.*; and in some cases, even 8*l.* per acre.

† General Report of Scotland, vol. ii. p. 74; Gloucestershire Report, p. 196; Berks Report, p. 305.

‡ Berks Report, p. 305.

the system adopted by the farming gardeners near London, the garden may contain an acre with advantage. By substituting the plough for the spade, the work will require less attention; the necessity of having a professed gardener, accustomed to digging, will be prevented;—and a considerable expence saved*.

The propriety of enclosing a garden substantially, cannot be too strongly inculcated. A wall of stone or brick, from seven to ten feet high, is the preferable fence, as it answers the purpose, not only of shelter, but of preventing every species of intrusion, even that of poultry, so destructive to gardens, and frequently the source of much irritation, where the garden becomes an object of particular attention. Walls of brick, however, are much to be preferred to those of stone. The brick, when once heated, retains its warmth for some time, often during the space of a whole night, and absorbs all the moisture with which it comes in contact; whereas stone-walls grow cold immediately after sunset: and whenever warm air touches a stone that is colder than itself, the air is decomposed, the matter of heat entering the body of the stone, and the watery particles remaining on its surface; and this moisture frequently causes the rotting of the fruit.—All walls preserve fruit much better when coped.

The articles raised in a farmer's garden, ought to be of easy culture;—of the sorts best calculated for family consumption;—nor ought some aromatic herbs, or medicinal plants, to be omitted. Fruit-trees may also be reared along the walls, and some, in the interior of the garden; for though they may injure the garden vegetables, yet the value of their fruit is generally far greater, than the amount of their pernicious effects†. Gooseberry, raspberry, and currant bushes also, which the industrious housewife can manufacture into various articles, and which in particular may in a great measure be the means of superseding the use of foreign wines‡, ought not to be neglected.

6. *Cottage Gardens.*—This interesting subject, shall be

* On the subject of farmers' gardens, more especially cultivated by the plough, some valuable hints will be found, in the Annals of Agriculture, vol. xxxix. p. 228, and 304.

† Bedfordshire Report, p. 458.

‡ The best white wine is made from the large Dutch white currant, but the sugar must not be of inferior quality. From the black currant, an excellent liquor is manufactured, which is called *gazle wine* in Kent. See the recipe in Marshall's Southern Districts, vol. i. p. 318.

considered under the following heads: 1. The advantages resulting from cottage gardens; 2. The proper size; and, 3. The mode of management.

1. No labourer in the country, can be in a comfortable state, without a garden. There are many cottagers unable to pay the rent of their cottage, when they have no land; but who, with the advantages of a garden, would find no difficulty in doing it. The cottage garden yields a great addition to the food, tends to promote the health of the family, and employs only their spare hours, in which nothing else would be done*. Hence, their families are supplied with culinary vegetables in summer, and roots in winter, at a moderate expence: and the value of this benefit, is greatly enhanced by the consideration, that it is the fruit of their own exertions†. The variety of food thus procured, contributes, not only to comfort, but to health. For the alleviation of some diseases, and the extirpation of others, is in many cases justly ascribed, to the more general introduction of cottage gardens. When a garden is of sufficient extent, the cottagers are also able, from its produce, not only to rear, but to fatten a hog, a valuable acquisition to every farm labourer, and indeed without whose manure, the garden could not be cultivated with success. Profit may sometimes also be derived from fruit; and in favourable situations, bees may be kept with advantage. The moral effects resulting from such a system, cannot be too highly appreciated. When these gardens are of a moderate extent, they merely occupy the leisure hours of the family; thus tending to promote the comfort of the whole, to produce habits of industry, and to cherish a taste for, and knowledge of gardening, in the rising generation‡.

2. The extent of the garden should be such, as not to occupy more of the labourer's time, than the regular engagements of the day will admit of. It is calculated, that the whole time which a farming labourer can spare from his

* It is an additional argument in favour of cottage gardens, that when a labourer is obliged to return home, in consequence of bad weather, he may do something in favour of his little plot, in case the weather clears up, instead of loitering in public-houses, and other places of public resort.

† Where a garden is small, it is an useful plan for the labourer, to procure a ridge of land, from some neighbouring farmer, for raising a stock of winter potatoes. The cottager manures the land, and gets the produce in return for the manure laid on, the benefit of which afterwards accrues to the farmer. This is an advantageous system to both parties.—*General Report of Scotland*, vol. ii. p. 64.

‡ General Report of Scotland, vol. ii. p. 62.

ordinary occupations, to be employed on his own land, is 273 hours, or about twenty-three days in all*; but as these consist of fractional parts, and as the greatest leisure occurs, when the spade is least wanted, there will be some difficulty in adapting it to the necessities of the garden. It is probable, however, that matters may be so arranged, that a cottager may, in some instances, with the assistance of his family, cultivate from a quarter to even half an acre, without improperly interfering with regular labour, provided a portion of it is kept in grass for feeding a pig. But in many cases, without assistance, he cannot advantageously attempt to manage one half of that quantity; and it is well known, that a small spot, when properly cultivated, will raise a greater and more valuable produce, than one of double the size, if the management be imperfect.

3. A cottage garden, ought to be managed on a simple plan, at the same time, some variety of productions is desirable, as, under a proper system, it may be made to yield a weekly, and almost a daily tribute, to the table of the cottager. Much must depend on the cottager being supplied with good seeds; for five shillings per annum, laid out in the purchase of seeds, properly selected, and sown in due season, would render his garden doubly valuable†.

The fittest articles for cultivation in a cottager's garden, are, summer cabbage, winter kail, potatoes‡, carrots, turnips, beans, leeks, and onions§. French beans are recommended as being very productive and profitable; and the imperial cabbage, as being early, of a good size, and fine flavoured. At Wytham near Oxford, the culture of strawberries, in cottage gardens, has been found productive‖. In other districts, the gardens of cottagers contain gooseberries and currant bushes, by which they frequently make some profit among their more opulent neighbours¶. Useful herbs, as balm, mint, parsley, chamomile, &c. ought not to be neglected. In Cumberland, cottagers often pay

* Gloucestershire Report, p. 199.

† Communication from Mr. Salisbury, of the London Botanic Garden.

‡ Cottagers should cultivate both early potatoes, as the champion or bread-fruit; and the red apple, or the red Cheshire, for late use.

§ Plain directions for the culture of these plants in cottage gardens, by the late Mr. Nicol, are inserted in the General Report of Scotland, Appendix, vol. iv. p. 426.—It has been remarked, that the gardens of labourers are frequently seen better cultivated than those of farmers, as the labourer occupies no other land to distract his attention from the culture of his garden.—*North Riding Report*, p, 180.

‖ Berks Report, p. 306, note.

¶ Bedfordshire Report, p. 458.

their rent from the produce of two or three trees of the Carlisle codlin*. Other fruit-trees may also be planted with profit, but unless a cottager or his family, have a turn for horticulture, and the soil and climate are favourable to the production of fruit, it is more advisable to restrict his attention to the common vegetables.

The benefit of a garden to cottagers, must greatly depend on its being well enclosed†;—on its having no forest trees planted in it‡;—and on the ground being well trenched, for if shallow, moisture is not retained in the soil, and its fertility is soon exhausted. In favourable situations, bee-hives are kept with profit. Bee husbandry, however, requires so much attention, skill, and management, that it ought to be attempted only by those who have a real taste for the pursuit.

In some parts of England, the gardens of labourers, and the entrance to their cottages, are adorned by flowering creepers, shrubs, and plants; which, though not attended with any profit, yet indicate a greater attention to neatness, and an enjoyment of more comfort, than the occupiers of the miserable unadorned huts in other countries, can possess§. The sight of such *superfluities*, is a gratifying voucher, in the words of Burke, "*That necessaries are not* "*wanting.*"

7. *Village Gardens.*—Round many villages and small towns, gardens of a moderate size are numerous and productive. It is a fortunate circumstance, when manufacturers and mechanics take a delight in them, since their

* See a description of this species of apple; General Report of Scotland, Appendix, vol. iv. p. 460.

† A good fence is necessary, as labourers are obliged to be from home a great part of the day, and sometimes take their families with them into the field.—*Gloucestershire Report*, p. 197.

‡ In some cottage gardens, forest trees are to be met with, though injurious to the produce, and in particular the ash, which on no account ought to be tolerated in that situation. The ash is frequent in such situations in Scotland, in consequence of an old Scotch statute, which required the planting of a certain number of ash trees, for every house that was built.—See *General Report of Scotland*, vol. iv. p. 432.

§ Derbyshire Report, p. 214.—The situation of the Irish peasantry, is extremely different from the same class in England. Excepting near populous towns, the general hire given to labourers in Ireland, is only eight-pence in winter, and ten-pence in the summer and spring months. It is evident, therefore, that a large proportion of this class in Ireland, must be in an extreme state of poverty; and so far from being able to attend to minutiæ, and neatness about their cottages, they often find it difficult to keep themselves and their families in existence.—*Communication from Edward Burroughs, Esq.*

health is promoted by the exercise in the open air, for which an opportunity is thus afforded; while at the same time, any tendency to immorality, is greatly checked, by an agreeable and useful means of occupation. The village garden is frequently the retreat of the occupier, in the summer evenings, after the labours of the day, where he agreeably employs himself, in watching over the progress of his crops, and the success of his exertions. In those manufacturing villages, or small towns*, where a number of inhabitants have gardens, a taste for keeping them in good order is prevalent, and few instances of dissipation occur†. In such gardens, not only aromatic herbs, and medicinal plants, are cultivated, but flowers of various sorts are raised, as carnations, pinks, auriculæ, polyanthus, &c. by the sale of which some money is obtained. The Florist Society at Paisley, in Scotland, is a sufficient proof of the advantage to be derived, from directing the attention of manufacturers to such innocent pursuits. The rearing of beautiful flowers, is found to improve their taste for manufacturing elegant patterns of fancy muslin; while the florists of Paisley, have long been remarked, for the peaceableness of their dispositions, and the sobriety of their manners‡.

3. *The Rent of Gardens.*

The most superficial observer must be satisfied, that the value of landed property, has been considerably augmented, by the increase of gardens. From their artificial riches;—their high cultivation;—and their great fertility and produce, the rents afforded, are higher than those derived from arable or pasture land§. The expences, however, are so great, that the rent, in proportion to the produce, is often moderate.

* A carpenter at Steyning, plants about 20 rods of his garden with what is called "*the under ground onion*," and potatoe sprouts, and sells annually 20 bushels of onions at 10*s.* per bushel, and 30 bushels of potatoes at 2*s.* or 13*l.* in all. As there are 160 rods in an acre, the above is a large return. He also raises radishes and celery on the same ground. *Communication from Mr. Bannister of Steyning.*—The ground onions are sown in March, as potatoes, and earthed up like them. The principal advantage derived from cultivating them is, their being earlier than the common onion, unless the latter are sown in autumn, and transplanted in the spring, which is often done in the neighbourhood of London, with the aid of glasses.

† General Report of Scotland, vol. ii. p. 65.

‡ Ditto, vol. iv. p. 422.

§ Essex Report, vol. ii. p. 131.

The rent of common garden ground, in the neighbourhood of Fulham, Turnham-Green, Brentford, and other places near London, is from 6*l.* to 7*l.* per acre. Nearer London, and where the ground is rich, the rents rise to 10*l.*; and where a garden has a considerable extent of wall, covered with choice and thriving fruit-trees, the rents are, according to the quantity and goodness of the walls and fruit-trees, from 15*l.* to 20*l.* per acre. In each of these cases, the rents are exclusive of forcing-houses; and the several gardeners have also to pay for tithes, taxes, and assessments, from one-half to two-thirds of the amount of the rents*.

The rent of the best garden ground near Edinburgh, an. 1814, was, on an average, from 8*l.* to 12*l.* per statute acre, for rent alone, tithes not affecting the occupier of land in that part of the kingdom. It is remarked, however, that unless the soil and exposure be particularly excellent, the tenant cannot have a profitable bargain at such rents, and that the land is likely to suffer from over-cropping, unless a sufficient quantity of manure can be procured†.

The garden ground at Sandy, in Bedfordshire, rents at from 2*l.* 10*s.* to 3*l.* pet acre, subject to the occupier paying tithes, taxes and assessments; and a field manured and cleaned, and in a state fit for producing potatoes or onions, will only let for one year, at from 5*l.* to 6*l.* per acre‡; while in the neighbourhood of many of the third and fourth rate towns of Scotland, from 6*l.* to 8*l.* and even 10*l.* per statute acre, is often paid for land upon which potatoes, and other vegetables, are cultivated§. In the neighbourhood of sea-

* Communication from John Middleton, Esq.

The necessity of accurate inquiry, is strongly exemplified by the following anecdote. A gentleman had mentioned in conversation to the author, that some gardens near Brentford were let for 80*l.* per acre. He was requested to ascertain the fact, when he stated in a letter, dated December 13, 1815, "That *a little mistake* had been made in the rent, which is only 40*l.* per annum, instead of 80*l.*" and after all, the rent turned out to be only about 20*l.* per acre, per annum. It is said that some land is let, near Hoxton, to some London citizens who amuse themselves with gardening, at the rate of 5*l.* for a plot of ground containing only two hundred square yards, which is the highest rented lend, *for cultivation*, known in the kingdom.

† General Report of Scotland, vol. ii. p. 89.

‡ Bedfordshire Report, p. 457.—The soil at Sandy, is so favourable to vegetables, that cucumbers and onions are sown broad-cast, in the open fields. The produce is partly sent to the London markets.

§ General Report of Scotland, vol. ii. p. 93.—The acre mentioned in this chapter of the General Report of Scotland, is the Scotch one; which is one-fifth more than the English. A proportional deduction from the rents therein specified, has been made, to make the rent applicable to the English or statute acre.

port towns, market-gardeners are found peculiarly useful; for nothing tends more to preserve the health of seamen, than a plentiful supply of vegetables, not only when on shore, but to be consumed at sea.

4. *Means of Improving the Art of Gardening.*

With a view of exciting emulation, it is a good plan, to have annual shows of fruits or vegetables, for the purpose of directing the attention of gardeners to the best varieties of the different sorts. In Manchester, they have celery shows*, and in other parts of Lancashire, those for gooseberries, &c. But the institution of horticultural societies, is attended with still more important consequences. A society of that description was established in London in 1805, which is conducted with much ability and success; in 1809, another was formed at Edinburgh, under the title of "*The Caledonian Horticultural Society*†;" and one has been lately established in Dublin, which is conducted with great spirit. Institutions of this description, must promote horticultural improvements, by exciting emulation;—by facilitating the communication of the valuable knowledge, often acquired by individual practical gardeners, from the result of their own experience;—and by fostering a taste for horticultural pursuits in every class of society, from the great landed proprietor, to the possessor of a cottage garden‡.

Perhaps nothing is now wanting, to complete the science of horticulture in this country, but that of sending persons, properly qualified, to examine the state of gardening on the Continent§, and to promote the introduction of such im-

* Derbyshire Report, vol. ii. p. 213.

† The objects of the latter institution are declared to be, "The promoting and improving the cultivation and improvement of the best kinds of fruit;—of the choicest flowers;—and of the vegetables which are most useful in the kitchen." The display of fruits, flowers, and vegetables, at some of the meetings, has been such, as to draw forth the admiration of the most experienced amateurs, and of the best practical judges. Upwards of 150 prize medals have been distributed by the Society since its institution; and a number of valuable papers have been published in its memoirs.

‡ It may be proper here to mention a curious fact recorded in the Survey of the Hebrides. A cottager there, had his cabbages much injured by the caterpillar. He surrounded his little garden *with hemp*, and was no more molested by them, the smell of that plant being noxious to insects. The same idea exists in France, as appears from the following paragraph:

"Quelques personnes ont cru reconnaître qu'on semant du chauvre sur toutes les bordures d'un terrain, les chenilles n'ont point dépassé cette barrière, quoiqu'elles infestassent tout le voisinage."

§ On the recommendation of the author of this work, that plan has been adopted by the Horticultural Society of Scotland, its intelligent Secretary,

provements as can be discovered there, or in other countries*, in the management of fruits, or of garden vegetables.

II. *Of Orchards.*

It has been a subject of dispute, whether the system of occupying land as an orchard, is advantageous to the individual, and to the public; and whether the soil might not be more usefully employed. In some situations, as in steep banks†, where they are sufficiently sheltered from cutting winds, there can be no doubt, of the superior pecuniary profit derivable from orchard trees, compared to any other species of produce; more especially to a small farmer, who attends personally to the whole business, and whose wife and children are his assistants‡. In various cases also, the produce of an orchard, in favourable seasons, will pay the rent of the industrious cottager§. But whether it is the profitable appendage to a large farm, and advantageous on an average of years, either to the landlord or the tenant, is a different question‖. It is objected to the formation of an orchard, that the returns, for the first twenty years, will be small, and that it will be thirty years, before the landlord can put any additional rent on his land, on account of his plantation. But this depends upon the management. With due care, the land may be cultivated, for several years, by the spade, with advantage to the plants, and benefit to the proprietor; inasmuch as the loosening of the earth, and manuring it well, is advantageous to their growth; and when the plants have got to a size, to protect themselves

Mr. Neill, having gone to the Continent, for that purpose, in July 1817. Much useful information may be obtained from a country, where, it is said, that no species of fruit tree, that the country was ever possessed of, has become extinct.—*Vanderstraeten's Improved Agriculture*, p. 160, note.

* It is probable also, that much useful information might be obtained from China, regarding fruit trees and gardening.

† General Report of Scotland, vol. ii. p. 182.

‡ Marshall's West of England, vol. i. p. 233. § Berks Report, p. 475.

‖ This will in a great measure depend on the peculiar fitness or otherwise of the soil and situation of the spot selected, for apple culture. Mr. *William Smith*, in carrying on the investigations for his large *map of the strata of England*, &c. discovered, among some other things relating to vegetable products, that all the chief cider districts, and the sites of all the best apple orchards, were on the same stratum of *red marl*, which stretches across the island from Dorsetshire to Yorkshire. Wherever it appears, the soil is fitted, by nature, to the purposes of orcharding, in a peculiar degree, perhaps more so than any other in our island. *Comm. from Mr. Farey.*—On which Mr. Middleton observes, that valuable fruit, hops, and corn, can only be raised, with much success, on calcareous soils.

from pigs and sheep, the ground may be laid down, in good heart, and become profitable pasture.

The profit of a tenant from an orchard, may arise, from selling cider, either as soon as it is made;—or after keeping it for some time;—or disposing of the fruit;—or using the cider in his own family, in lieu of beer.

In a good year, an acre will produce 800 gallons of cider, which, at 4*d.* per gallon from the mill, is 13*l.* 6*s.* 8*d.* subject to the following deductions: 20*s.* for tithes, 40*s.* for making, and 10*s.* for gathering; total, 3*l.* 10*s.*; balance of profit 9*l.* 16*s.* 8*d.* But it is seldom that such a crop happens above once in three or four years. At 400 gallons, which is considered to be a fair average, the return would be 6*l.* 13*s.* 4*d.* per acre, subject proportionably to lesser deductions.

If the farmer, however, has capital sufficient to retain the produce of his orchard, and suitable accommodation for keeping it, until a proper opportunity for a sale occurs, should a bad year take place, the price will be advanced to 8*d.* or 1*s.* per gallon, and a greater profit, than in the cases above stated, may be obtained. Few farmers, however, have such cellars to keep it in, and all such who have not, must either sell it, or drink it soon after it is made.

But where farmers reside near a canal or navigable river, the most certain profit arises, by selling the fruit for table use, (the finer kinds for desserts, and the coarser sorts for baking and stewing), instead of converting it into cider. For the same quantity of fruit, (eleven seams of nine pecks each), which would fetch, 8*l.* 16*s.* unground, would only bring in cider, 3*l.* 15*s.**

It is objected to orchards on large farms, that they are apt to interfere with the more important concerns of husbandry; and to abstract that manure, which ought to be applied to the arable land. The cider system has likewise a tendency to introduce a dissoluteness of manners; nor is cider so wholesome or strengthening a liquor as malt liquors†.

But it is contended, that lands in pasture, worth only from

* Gloucester Report, p. 238.

† Marshall's West of England, vol. i. p. 233.—Inferior grass lands are often much benefited by being planted with fruit-trees. As orchards, the shelter of the trees, and the dropping of the leaves in autumn, promote their fertility. They should not, however, be planted too close, as the trees would soon become mossy, and decay; and the grass, from being too much sheltered, would become sour and unkind: both objects would thus be defeated.—*Remark by Edward Burroughs, Esq.*

12*s.* to 30*s.* per acre, would probably be worth 3*l.* per annum as an orchard;—that Great Britain contains many thousand acres, capable of that species of improvement, at a small expence, and within a short period of time*;—and that by increasing the better sorts of fruit, and pursuing a proper system, fruit grounds and orchards, might be rendered a source of riches to those districts, where they can be successfully cultivated, and at the same time, would prove a source of benefit to the nation at large†. Many instances might be adduced, where small farmers have been enabled to pay their rents, from the produce of their orchard harvest, where care had been taken, in selecting the most useful sorts of fruit trees, and properly managing them.

It is the more necessary to attend to orchards, as in the opinion of one of the ablest naturalists this country has produced, there is no reason to suppose, unless a great change in the heat of our climate should take place, that vineyards will succeed in England; or that the grape will ever, in such a climate, afford a liquor, equal in merit, to the produce of the apple or the pear, when the liquors these afford, shall reach their greatest state of perfection‡.

Several points are here to be considered, as, 1. The kinds of fruit-trees raised in orchards; 2. The distance at which they are planted; 3. The rent given; 4. The produce; 5. The under-crops; 6. The stock that are kept in them; and, 7. Some particulars regarding the mode of management.

1. *Sorts of Trees.*—Besides the pear and the apple, several other trees are raised in orchards. Of these, *cherries* are in some districts, as in Kent and Hertfordshire, the most abundant. They begin to bear about ten years after they are planted; and on an average, they will produce annually, about six dozen of pounds, from the tenth till they reach their twentieth year. A full grown tree, will produce 50 dozen of pounds in a good year. The price varies, from 10*d.* to 3*s.* per dozen of pounds. At 2*s.* per dozen of

* Herefordshire Report, p. 91.

† Marshall's Gloucestershire, vol. ii. p. 295. In regard to the idleness and debauchery which cider orchards are alledged to occasion, it is justly observed in the Somerset Report, p. 126, "That we ought not to confound the abuse of a thing, with its intrinsic value."

‡ A Treatise on the Culture of the Apple and the Pear, by T. A. Knight, Esq. p. 44, note. That, however, is of less consequence, as an acre of pear trees, the fruit converted into perry, is found to equal what many persons in France, derive from good vineyards.

pounds, a tree would yield 5*l.* per annum. The gathering gives considerable employment to the poor*. Some orchards in Kent, have *Spanish chesnuts* planted in them. The produce is extremely uncertain, though very profitable in good seasons†. *Walnut trees* are likewise to be met with; and are calculated to yield about 5*l.* 5*s.* per tree per annum‡. *Filberts*, under proper management, are a profitable crop in an orchard, but they are supposed to be great impoverishers of the ground§. *Plums* are sometimes raised with advantage near good markets‖. Where apples thrive, as in the counties of Somerset, Devon, and Cornwall, other fruits are too apt to be neglected.

2. *Distance and Mode of Planting.*—In Devonshire, orchard trees are small, and are seldom found standing at a greater distance than sixteen feet from each other. In some places their branches are so interlocked, intermixed with dead wood, and covered with moss, that the fruit is hardly visible¶. To remedy this objectionable practice, it is recommended, that the trees should be planted at sixty feet every way from each other, by which means they become productive, and the pastures suffer but little injury. The desire of having a great deal of fruit, on little ground, is the cause of planting too close; but by this method, the intended object is defeated**.

In the grass grounds of Gloucestershire, and arable fields of Herefordshire, twenty yards is the usual distance; sometimes even twenty-five; a chain, or twenty-two yards, is a proper medium††. Young trees ought not to be planted in the same spot whence the old ones were removed. The roots of the old tree, are the habitations of multitude of worms, and they should be carefully removed, otherwise they will do serious damage to the young trees.

3. *Rent.*—The orchards in Somersetshire let at from 3*l.* to 6*l.* per acre‡‡. In Hertfordshire the rent is about 4*l.* per acre. They are generally under grass, and fed with sheep§§. At Coldstream, in Scotland, an orchard is let for 21 years, at 6*l.* per acre for the first seven, and 7*l.* for the remaining

* Herts Report, p. 443. † Marshall's Southern Districts, vol. i. p. 305.
‡ Oxfordshire Report, p. 220. The high value of walnut-tree wood, as well as the profit derived from the fruit, seems to require a more extensive planting of them. See Derbyshire Report, vol. ii. p. 215.
§ Marshall's Southern Districts, vol. i. p. 307.
‖ General Report of Scotland, vol. ii. p. 180.
¶ Devonshire Report, p. 239. ** Somerset Report, p. 220.
†† Marshall's Gloucestershire, vol. ii. p. 271.
‡‡ Somerset Report, p. 124. §§ Herts Report, p. 143.

fourteen years*. In the West of Scotland, the rent is still higher, varying from 6*l.* to 12*l.* and sometimes it is as high as 16*l.* per statute acre; but the produce is sold *as fruit*, to an extensive manufacturing district, and not converted into cider†.

4. *Produce.*—In orchards, a full crop once in five years, and an average crop once in three years, is as much as can fairly be expected‡.

In Devonshire, the average produce of an orchard is reckoned at $3\frac{2}{3}$ of a hogshead per acre, per annum. The average price at the press is 50*s.* consequently the average produce of an acre is about 8*l.* 10*s.* per annum§.

In Herefordshire, from 24 to 30 bushels of apples will make a hogshead of cider, or 110 gallons. Twenty hogsheads of cider have been made from an acre. This is only at the rate of 40 trees per acre, and half a hogshead per tree. The average price of cider is from 25*s.* to two guineas per hogshead.

The entire produce of four counties, (Gloucestershire, Monmouth, Hereford, and Worcester), may be calculated at 30,000 hogsheads, raised at the rate of 20 hogsheads per acre, on 1500 acres‖. At 2*l.* per hogshead, this would amount to 60,000*l.* or 40*l.* per acre. At 30*s.* per hogshead, the return would be 30*l.* per acre.

It has been disputed, whether pears or apples ought to be preferred in orchards. The pear in general produces an inferior liquor, but it possesses many advantages over the apple, for general culture. It flourishes in a greater variety of soils;—it is more ornamental;—its fruit is less liable to be stolen, (those sorts which are proper for perry, being unfit to be eaten, or applied to common culinary purposes);—and it is more productive, trees in general, when nearly full grown, producing annually 20 gallons of liquor; and as each acre is capable of containing 30 pear trees of the usual dimensions, hence the average produce may be stated at 600 gallons per acre. On the other hand, though an acre planted with apple trees, will produce but one-third as much liquor, yet the apple begins to bear at an earlier age, and cider will ever be generally preferred to the juice of the pear¶.

Apples are superior to cherries, as they will keep till they

* General Report of Scotland, vol. ii. p. 166. † Ditto, p. 181.
‡ Berks Report, p. 306. § Devon Report, p. 244.
‖ Marshall's Gloucestershire, vol. ii. p. 392.
¶ Herefordshire Report, p. 90.

are wanted, either for sale or use; but cherries will burst or drop, if they are not gathered when ripe, and there is not always a demand for them*. Cherries are likewise apt to be destroyed by birds.

It is said, that the importance of apples, *as food*, has not hitherto been sufficiently estimated. The labourers in Cornwall, consider them to be nearly as nourishing as bread, and more so than potatoes.—In the year 1801, when corn was so scarce and dear, apples, instead of being converted into cider, were sold to the poor; and the labourers asserted, that they could stand their work, on baked apples without meat, whereas a potatoe diet, required either meat or fish†.

5. *Under Crops.*—These are of various sorts, depending on the age of the orchard;—on the extent of distance between the trees;—on the situation of the orchard;—on the quality of the soil, and other less important circumstances; but they may be classed under the following heads: arable crops;—garden crops;—grass;—and miscellaneous articles.

In young orchards, the ground, if flat and arable, is not unfrequently put under a rotation of corn and green orops; as, 1. Oats; 2. Potatoes, with dung; 3. Oats, sown down with clover and rye-grass; 4. Hay; and, 5. Hay‡. But it is much more advisable, to cultivate the land with the spade than the plough. The harness and the implement do so much injury to the trees, that they cannot be depended on for the production of fruit. Their roots, also their drip, and shade, are destructive, not only to corn, but to clover and to turnips; impeding the free circulation of air, and obstructing the teams when ploughing. While the trees are young, however, the land cannot be too much stirred§.

In Gloucestershire, orchards are kept in grass, in which state, under ordinary management, the progress of the trees is comparatively slow, for want of the earth being stirred about their roots, while the trees are injured (more especially low-headed drooping trees), by the grazing stock. Cattle also, if admitted at the season when the fruit is growing, destroy all that is within their reach, and often suffer from the fruit lodging in their throats. Notwithstanding these disadvantages, when the trees become of such a size, as to be injurious to the arable crops, the ground ought to

* Berks Report, p. 364.
† Communication from the Rev. Robert Hoblyn.
‡ General Report of Scotland, vol. ii. p. 186.
§ Marshall's Gloucestershire, vol. ii. p. 286.

be converted into a state of grass*. The herbage produced in an orchard also, comes very early in the spring, when it is peculiarly valuable to the farmer. Under judicious management, it is never suffered to grow long or coarse; and an orchard in this condition, will be found to support a very considerable quantity of stock†.

The fruit-gardeners near London, have, what they call an *upper* and *under* crop, growing on the same ground at one time. The *upper* crop includes apples, pears, cherries, &c. The *under* crop consists of raspberries, gooseberries, currants, strawberries, and other fruits, shrubs, and herbs, which are known to sustain the shade and drip from the trees above them, with the least injury‡. Near Glasgow, small fruits are in great demand, and are frequently grown in orchards. There are instances of 100*l.* being got for an acre of gooseberries, near a manufacturing town§.

In young orchards, the spaces between the trees, are in some cases occupied with hops‖, and in others with filberts. In grown orchards, the filbert is frequently seen, though far from generally. Some old orchards are in permanent sward; others bear arable or garden crops: some are in sainfoin; others in lucern¶. Sometimes the interstices are used as nursery ground; but this seems a bad plan, as it exhausts the land, and prevents its being properly stirred.

In Devonshire, the trees of orchards are kept so low, that the use of the land is in a great measure lost. Horses are sometimes allowed to run through them; and calves in early spring; but grown cattle and sheep are at all times prohibited; likewise swine, when the fruit is on the trees**.

6. *Stock.*—Cows are frequently grazed in orchards when in pasture. To prevent the animals from eating the fruit, when the trees are loaded with apples, their heads are sometimes secured to the fore feet, by means of halters††.

The same plan, to prevent cows from raising their heads

* Marshall's Gloucestershire, vol. ii. p. 286.

† Herefordshire Report, p. 91. ‡ Middlesex Report, p. 324.

§ General Report of Scotland, vol. ii. p. 180.

‖ This plan was strongly recommended by the late S. Dyot Bucknall, Esq. If hops are cultivated by the spade, they can do no injury to the roots of the trees, if judiciously worked, while the loosening of the earth, to a good depth, and the liberal expenditure of manure, tends evidently to the benefit of the plants, as well as to the ensuring rich pasture, whenever the size of the trees is such, as to be prejudicial to the further cultivation of hops. It is evident, however, that this practice can only be applied to congenial soils.—*Communication from Sir Charles M. Burrell*, Bart. M. P.

¶ Marshall's Southern Districts, vol. i. p. 319.

** Marshall's West of England, vol. i. p. 223.

†† Report of the Norman Islands, p. 123.

high enough to browse the branches of the trees, is adopted in the cherry orchards of Essex*.

Sheep are injurious to orchards, by barking the trees, which may easily be obviated by a wash of lime and night-soil, applied to the height of three or four feet on the stem of each tree, previous to the sheep being admitted. This precaution is particularly necessary for the first ten years after an orchard has been planted.

It is an useful practice, to turn hogs into orchards, and give them there beans or other food. The turning up the earth, in search of roots, is thought to be of use to the trees. and tends to the destruction of weeds, grubs, and insects†, It is necessary, however, to use precautions, when any species of stock is admitted into an orchard, as swine are fond of fruit; sheep eat it with avidity; and deer are still more partial to it‡.

The chief orchards in Scotland, being either upon banks, so steep as to be inaccessible to cattle, or in clayey soils, which might be injured by poaching, are seldom pastured. Yet orchards thus kept, must have a disgusting appearance, since weeds, instead of grass, are likely to abound. Grazing with sheep or cattle, and if necessary, using some manure to the trees, would seem to be preferable to the admission of swine un-rung. The trees in general, are only trained as half-standards. The grass is therefore cut with the scythe, and given to cows and horses, to whom it is acceptable, though there are not wanting prejudices against this practice§. It is not approved of in England, where mowing the grass of orchards is thought to exhaust the ground so much, as to be destructive to the trees in it. Some orchards which were very productive when fed, have produced nothing after a few years mowing‖. Perhaps this may, in part at least, have been owing to other causes; and, if tried, some kind of manure or compost, might doubtless be found, to supply the place of the dung of the cattle.

7. *Management.*—The forming an orchard is a work of time. Where shelter is necessary, a belt of planting, 50 feet wide, and 30 yards from the fruit-trees, should be prepared. It is advisable, to plant only 25 feet of the belt first, and the remaining 25, about 12 or 15 years afterwards: a

* Essex Report, vol. ii. p. 132.
† Marshall's Southern Districts, vol. i. p. 312.
‡ Marshall's Gloucestershire, vol. ii. p. 322, note.
§ General Report of Scotland, vol. ii. p. 185.
‖ Herts Report, p. 143. Tethering stock in orchards, is a better plan than mowing, or allowing them to pasture at large.

close screen is thus secured, for a much longer period, than if all the trees had been planted at once*.

No excellence of culture or management, can make up for the want of a dry and sound bottom. Hence the necessity of draining thoroughly, whenever moisture is suspected. When young trees are planted, the earth should be dug sufficiently deep, to facilitate the passage of the water, that it may not injure the roots. The surface should likewise be trenched with a spade, the year before planting, to the depth of at least two feet, and as much *long manure*, ashes, lime-shells, or sand, used, as can be spared, or conveniently got, increasing the quantity as the soil is poor.

On soils that have a cold, and hard subsoil, it is advisable, when planting the trees, to put a flag, or pavement under each tree, in order to prevent the tap-root from striking into the unfertile soil below, which often occasions their producing bad fruit; and often prevents them totally from bearing.

It is sometimes necessary also, to give an artificial and protecting subsoil. For that purpose, a pit ought to be dug, eight feet deep, and filled with brick-bats, cinders, rubble-stones, &c. at the top of which, two or three coarse flags should be laid, to prevent the main roots of the trees from descending, and to give them a horizontal direction†.

It is recommended as an useful practice, in wet soils, or where the substratum is not suited to the apple or the pear, to plant the trees, on hillocks of easy ascent, as for instance, one foot higher in the centre than the level of the field, and sloping gradually to that level, for three or four feet every way from the centre. By that practice, the roots will naturally follow the good surface earth; whereas, if they are planted in holes, the roots are apt to shoot into the prejudicial subsoil, to the eventual injury of the plants, by canker and other diseases. When trees are thus planted on small hillocks, the under-drains may pass between the rows with greater utility‡.

* Herts Report, p. 143.

† General Report of Scotland, vol. ii. p. 183. In all the old monastic orchards in Scotland, this plan was followed. No tree, however, can stand, without having some of its roots at a depth proportioned to its top; and if flags prevent their descent immediately below the trunk, they must descend as soon as they can get beyond the flags: in the case above described, the benefit must be derived, from *having a pit below filled with rubble*, in and round which the roots may range better, than in a hard and cold subsoil, in addition to the having no unfertile matter to injure their roots.

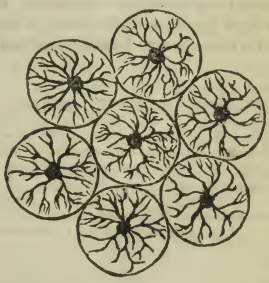
‡ Communication from Sir C. M. Burrell, Bart. M. P.

For guarding the stem of trees in orchards, from the attacks of sheep and hares, a *white-wash* is applied, composed of lime, night-soil, and water, of such a consistency, as to be put on with a brush. Sometimes, not only the lower part, but the whole stem is frequently seen smeared over*.

Others recommend wrapping up the trunk of the young tree with straw ropes, for the first 18 years, which effectually protects the bark from the attacks of hares and rabbits†. Tying bunches of furze (whins), round the stems of trees, likewise prevents all injury‡.

It is a maxim in the management of the orchards in Scotland, (which is peculiarly necessary in that country, on account of the variableness of the climate), to plant a considerable number of different sorts, both of the early and the late kinds: for at one time, the blossom of a particular variety, may be destroyed by frost or a moist north-east wind, while the blossom of another kind, either earlier or later, may escape.

Where the Devonshire plan is adopted, of covering the ground with trees, they should be planted in *quincunx*, or in the centre of circles, in contact with each other, according to the following plan§.



To understand this properly, the trees should be planted at 15 yards distance from each other in the rows, and 13 between the rows, and the trees of the second row should be in the middle between the trees in the first and third

* Marshall's Southern Districts, vol. i. p. 310.
† General Report of Scotland, vol. ii. p. 164. ‡ Ditto, p. 191.
§ Bedfordshire Report, p. 312.

rows. If a larger distance is preferred, the proportion of 15 in the row, to 13 between the row, should be preserved.

In all the orchard districts, there are the greatest complaints of the decay of trees, and the state of unproductiveness into which they have fallen*. Where that takes place, the plan of peeling the outer bark of these decayed trees, (as already explained in the Section of Gardens), and either trusting to their natural growth, or engrafting on them new varieties, ought to be tried.

An easy remedy for the white blight, or American bug, has been discovered. It is only necessary to clean the diseased parts, and to apply to them common fish-oil, such as is used in coarse out-door work, with a brush, and the nuisance may be got rid of, without injury to the plants†.

It is a rule, that standard trees in orchards, should be trained, pruned, and cleaned, with as much care as wall-trees, in order to ensure their productiveness, at least while they are young. When the stems are well swelled, the head well formed, and there are three or four flourishing main branches, it is only necessary to take off the annual shoots which form on the limbs, or any foul and ill-directed shoot accidentally produced.

It cannot also be too strongly inculcated, that to permit young plants to bear fruit *for some years*, is eventually to do essential injury to their future fruitfulness and duration‡.

* Surrey Report, p. 422.

† Communication from Sir C. M. Burrell, Bart. M. P.—*Fish-oil* is preferable to linseed-oil, on account of its stench, which is highly injurious to insects. Olive-oil is also injurious to them, and promotes the health of the trees. It is said, that to have water applied with a hand-brush, would answer, and it is a cheap application. The following liquid is the most effectual of any:—Take two ounces of quicksilver, and the same quantity of salt. These two substances to be mixed together, so as to kill the quicksilver, by stirring them about with a stick six or seven inches long. The hand not to touch the mixture on any account.—When the two substances are well incorporated together (which is generally in about five minutes), add one gill of rape-oil, and two table-spoonfuls of spirit of turpentine—Stir them till fit for use.—The liquid to be applied with a feather, and it will be found an infallible means of destroying every species of vermin, in houses, hot-houses, gardens, or orchards.

‡ Communication from Sir C. M. Burrell, Bart. M. P.

PART IV.

WOODS AND PLANTATIONS.

I. *Of Woods.*

THE occupation of land, either in natural wood, or planted timber, is attended with numerous advantages. Trees contribute to the ornament and the shelter of a country*; and the importance of timber, as applicable to naval uses;—to the building and repair of houses;—to the construction of machinery;—to husbandry;—to mines;—to various manufactures;—to utensils;—to fuel;—and to several miscellaneous objects, as the feeding of stock; the construction of bridges; the production of pitch and tar, &c. has been so frequently laid before the public, that these particulars need not here be dwelt upon†.

Notwithstanding these advantages, and though woods are considered by many, as amongst the most profitable lands in

* In a paper drawn up by the Right Hon. William Adam, (General Report of Scotland, Appendix, vol. iv. p. 472), the advantages of shelter, are ably explained; as well as several other important particulars connected with the success of plantations. See also Kent's Norfolk, p. 92.

† They are detailed in the Chapter on Woods and Plantations, in the General Report of Scotland, Chap. X. vol. ii. p. 197; and in Marshall, on Planting and Rural Ornament, vol. i. p. 47.—The advantages furnished by trees to the feeding of stock, are not much attended to in this country, though in others, as in Italy and Sweden, trees are considered a great resource. The leaves of the elm, the maple, and the poplar, are preferred in Italy; but those of the oak and the ash are also used, particularly mixed with others. They are gathered about the end of September or beginning of October, and after being spread on a pavement to dry, for three or four hours, they are put in wooden casks, or in pits covered first with straw, and then with clay or earth. There is no dry food on which cattle and sheep thrive better, than on leaves well preserved. *Professor Symonds' Communication, Annals of Agriculture*, vol. i. p. 207.—The sheep of Sweden, who are kept seven months in the house, have one meal every day, of the leaves of the birch, the willow, &c. *Communications to the Board of Agriculture*, vol. i. p 313.—The late Sir Cecil Wray found, that the boughs of the Scotch fir, given to sheep in snow, saved much hay, and kept deer perfectly well in winter.—*Lincolnshire Report*, p. 216.

their possession*; yet others contend, that whether in respect to the landlord or his tenant, to individuals or the public, woods are considerably inferior to corn and herbage. It is ingeniously urged, that as the kingdom advances in cultivation, woods and forests are made to disappear;—that when they vanish before population and corn, it may be considered as a most convincing proof of national prosperity;—and that to complain of scarcity of wood, is preferring a produce that yields only 20*s.* to another that produces at least 4*l.* per acre, per annum†.

In discussing this subject, it is proper to consider, 1. What soils are peculiarly calculated for the production of timber; 2. What soils may be applied to the growth either of timber, or of grain and herbage; and, 3. Whether those soils, which are peculiarly calculated for the growth of corn, or of artificial grasses, may not have some timber intermixed with them, without detriment to the corn or herbage.

1. There can be little doubt, that where the soil is not worth more than two or three shillings per acre, it can hardly be more advantageously employed than in the growth of wood, suited to its soil, situation, and climate; and there are very few of the most exposed and barren wastes, where, by proper care and attention, timber of one species or another may not be produced‡. By planting also, such wastes are often improved; the falling and putrefaction of the leaves, tending to thicken the soil, and to render it by degrees richer, and more capable, either of promoting the growth of timber, or of being converted into arable land§.

Where the land is steep and precipitous, and more especially covered with stones, there are no means, by which so much profit can be derived from the soil, as from woods. This is particularly experienced in some districts in the

* Kent Report, p. 146. † Sussex Report, p. 184, 185.

‡ West Riding Report, p. 129.

§ Staffordshire Report, p. 99.—In Flanders, barren lands have been planted in general with the Scotch fir, principally with a view of supplying them with the materials of future cultivation. It has been found, that in thirty-five years, an arable soil of from five to six inches thick, is formed from the decayed leaves. If the trees are then cut down, and young ones planted (for young trees produce the greatest quantity of leaves), the vegetable mould will become a foot in depth, and may then be cultivated in perpetual rotation, with all the various crops raised in the neighbourhood. This is certainly a tedious mode, but there is a profit from the trees in the interim, joined to the prospect of future improvement.

counties of Perth, Stirling, Dumbarton, and Argyle, where the annual produce of a statute acre of copse wood, may be stated at 1*l.* per annum (1*l.* 5*s.* per Scotch acre); a return which far exceeds, what could be drawn from the soil on which it grows, in any other way*. *In a favourable situation*, (as in the case of Somersetshire, to be afterwards mentioned), the profit is still more considerable.

2. In regard to soils calculated either for wood or cultivation, it is said, that the proprietors, in many instances, derive more profit from the sale of wood, than could be obtained from the rent of land, if cultivated. In some parts of England, where black sallow abounds, an acre, at twelve years growth, is worth 15*l.*, and pays better than the adjoining arable fields†. Where the Spanish chesnut is cultivated, instead of the black sallow, the profit is still more considerable. In Kent, the late Lord Barham cut down a plantation of chesnut, for hop-poles, at nine years growth, and drew from it 104*l.* per acre‡. In eleven years, a plantation of larch, on a very poor light loam, not worth more than from 6*s.* to 7*s.* per acre for cultivation, produced, for hop-poles, at the rate of 91*l.* per acre§, or 6*l.* 8*s.* per annum, subject to the usual deductions.

Much, however, depends on *the nature of the soil, and of the subsoil*‖. *The situation*, also, merits consideration, before we can properly decide, whether the growing of wood is to be preferred to cultivation.

Lord Bagot's woods in Staffordshire, are upon a gravelly loam, incumbent on a clay or marl bottom. It is a soil of so cold a quality, that it would not be worth a rent of 10*s.* per acre, if cultivated; and it pays much better when covered with timber and underwood¶.

In the county of Somerset, the ancient forest of Selwood, contained about 20,000 acres, of which 18,000 have been converted into arable, pasture, or meadow land; the re-

* General Report of Scotland, vol. ii. p. 249. † Herts Report, p. 145.

‡ Kent Report, p. 145.—This is about 10*l.* per acre, per annum, from which deduct taxes and other burdens, and it stills remains very profitable.

§ Kent Report, p. 146.

‖ In many cases, the successful growth of forest-trees, depends more on the underground, than on the soil itself.—The latter is principally of use in the early stages of the growth, but ultimate perfection entirely depends on the nature of the subsoil, its depth, soundness and moisture. Poor sandy soils in Norfolk, not fit for corn, and producing nothing but bent grass, will yield thriving timber, if the subsoils are loamy.—In some parts of France, soils incapable of producing crops of corn, are clothed with luxuriant timber.—See Young's Travels in France.

¶ Staffordshire Report, p. 98.

mainder still continues in a state of coppice. Much of the land that has been brought into cultivation, does not rent at more than from 10*s.* to 12*s.* per acre; whereas some of those coppices which lie towards the northern end of Selwood, though, from the soil and exposure, they cannot be cut oftener than in eighteen or twenty years, yet produce an annual value in timber and underwood, of from 15*s.* to 30*s.* per acre*.

In an extensive wood in the same county, but disafforested in the reign of Charles I., the profit of woodland, under any tolerable degree of management, may, it is said, be fairly taken at nearly double the value of the adjoining land, whether in an arable or pastoral state†.

The coldness and sourness of some descriptions of land, when brought from woodland into culture, tend much to depreciate its value, however it may be employed. In an arable state, it will not, in the first instance, produce grain kindly for many years. In a favourable season, it may yield a tolerable crop of oats, but it is totally unfit for barley, and unless it be heavily manured, is too poor for beans. Wheat is late of ripening, and requires more dung than can well be afforded. If in grass, from the lateness of its growth, the value of the land is much reduced, and it is less suited to the dairy, though that is the mode of application to which it is best adapted‡. But as a general rule, it may be laid down, that all land capable of bringing the oak to maturity, and not too steep or too rugged to be cultivated, should be applied to the purposes of agriculture§. After the most accurate investigation, it appears, that where the soil is of good quality, more profit is derived from cultivation, than from retaining land in wood||.

In most cases, however, the profit depends upon situation.

In the county of Wilts, notwithstanding the general use

* Somerset Report, p. 129.

† Somerset Report, p. 229.—But when cut only once in 20 years, it reduces the real annual produce, to half the nominal produce, or from 20*s.* to 10*s.*, and this subject to taxes and other deductions, which would diminish the real to about one-third of the nominal produce.

‡ Somerset Report, p. 233.—In a note to p. 234, it is stated, that Mr. Parsons, of West Camel, had greatly improved such wet clay soils, by burning all the earth and clay he could find in his ditches, with wood, and reducing them into a pulverized state; he mixed the whole with any manure he could command, and spread it with great advantage, on either arable or pasture land.

§ Marshall's Review of the Northern Department, p. 224, 225.

|| Derbyshire Report, vol. ii. p. 224, and 225.

of pit-coal has considerably diminished the consumption of wood and charcoal, for domestic purposes, the demand for underwood is still so very great, that woodland will not only yield a sufficient rent, *but, if in good situations*, and well managed, will produce at least half another rent, by the timber which may be raised, without any material injury to the underwood*.

In Somersetshire, the growth of coppice or natural wood, if secured from the south-west breezes, is so rapid, that the profit is more certain than from any other produce; and greater than any individual would believe, who has not had experience of it. From rapidity of growth, it is more profitable to cut down the coppice every twelve years, than to let it remain longer. An acre produces 16*l.* every twelve years, after the expences of cutting, carriage, &c. have been deducted. This is nearly at the rate of 28*s.* per annum, besides the accumulating value of the timber trees. This great profit, however, is principally owing to these woods being near coal-pits, where ash poles fetch a high price. The 28*s.* received in this case, at the distance of twelve years, is equal to 20*s.* per annum, liable to taxes, and some other deductions. But it would be difficult to let such land for cultivation, at a rent of even 10*s.* per annum†.

It were endless to go through the various other instances of profit derivable from woodland. It may be sufficient to add the following instances: 1. The woods belonging to Sir Joseph Banks, at Revesby, in Lincolnshire, pay at the rate of 45*l.* 7*s.* cut once in twenty-three years, which is 1*l.* 19*s.* 5*d.* per acre, per annum; but if let at 17*s.* per acre, per annum, payable half-yearly, and put out on simple interest, the amount would be the same‡. The land, however, is of so indifferent a quality, that it would not produce, if cultivated, more than from 10*s.* to 12*s.* per acre §. 2. The underwood of Col. Beaumont's woodlands in Yorkshire, is cut down every twenty-one years, and is worth, upon an average, 55*l.* per acre, besides 18*l.* worth of wood left to stand for a

* Wilts Report, p. 86. † Somerset Report, p. 128.

‡ If compound interest were allowed, as it ought to be, the comparison would be much in favour of cultivation. Deduct taxes and other burdens, and from 17*s.* it would be reduced to 10*s.*, and when the profits of a tenant are considered, it is supposed that a rent of 10*s.* is as much as could be obtained.—*Remark by John Middleton, Esq.*

§ Lincoln Report, p. 217. Marshall's Review of the Eastern Department, p. 12.

future fall. These woodlands, in general, if they were cleared of all timber, underwood, &c. and put into cultivation, which would be at an enormous expence, would, on an average, be worth only 5*s*. per acre*.

But, on the other hand, when land is cultivated, it yields a return every year; whereas in wood, the profit is only occasional, and in the case of timber, extremely distant; and various comparative estimates have been made, to prove the superiority of cultivation, particularly on good land.

In Derbyshire, a fall of wood of twenty-five years growth, varies from 40*l*. to 100*l*. per acre, clear of all expences of fencing, draining, and superintendence. About 65*l*. is nearly the average†. Forty pounds worth of timber, however, is always lying dead, in the trees remaining in the ground, deducting the interest of which, the rent of the woodland, is only 12*s*. 8½*d*. per acre, per annum. Compound interest on the 40*l*. at 3½ per cent. would reduce the value of the next cutting to 7*s*. 4*d*. per acre, and if calculated at four per cent. compound interest, the dead stock would be 66*l*. 12*s*. 8*d*. exceeding the cutable produce, by 15*s*. 2*d* ‡.

In the Weald of Sussex, the common system of husbandry is, a fallow, two crops of corn, and one of clover, the produce of which, during that course, is stated at 15*l*. 2*s*. or, for the four years, 3*l*. 15*s*. 6*d*. per annum§.

The highest produce, in the most favourable soils for wood in Sussex, is 1*l*. 0*s*. 5*d*.; consequently the gross produce by corn, is 2*l*. 15*s*. 1*d*. per annum, more than by wood, though obtained at greater expence‖.

Besides, were it admitted as a general maxim, that the strength of a country depends more upon the number of

* West Riding Report, p. 128. This is about 31*s*. per acre, which is equal to about 20*s*. clear of taxes. Mr. Surties, of Newbiggen, obtains upwards of 100*l*. per annum from 60 acres of woodland. *Northumberland Report*, p. 125.—In Cornwall, copse wood of common oak, cut down at from 20 to 30 years growth, sells at from 20*l*. to 60*l*. per acre. *Cornwall Report*, p. 98.—The tithe laws of England, in many cases, render it more profitable to raise wood than grain, in many descriptions of soil.

† This is about 27*s*. per acre, per annum, or 20*s*. per acre, deducting taxes, &c.

‡ Report, vol. ii. p. 224. The Reporter is a strenuous advocate for clearing many of the best woodlands, and bringing them under cultivation. Plantations, he admits, should at the same time be extended, over steep and stony wastes.—*Ditto*, p. 226, 236, and 261.

§ Sussex Report, p. 179.

‖ Darwin's Phytologia, p. 526.—1*l*. in 15 years, is less than 10*s*. per annum, after paying taxes, and other deductions. The rent would not exceed 7*s*. per acre.—*Remark by John Middleton, Esq.*

men, than the number of trees, and that those lands, which can be employed in the immediate production of animal or vegetable food, should not be occupied in the tedious cultivation of future timber*; yet still, there are exceptions to that rule, which well merit consideration.

In many districts, were they divested of wood, fuel could not be obtained, manufactures must cease; mines must be abandoned; several branches of husbandry, and the culture of hops in particular, could not be carried on: And when it is said, "Let timber then be imported," it is not considered, that the expence of conveying so bulky an article, more especially to inland districts, or places where trade is but little known, would be intolerable. Indeed, those only who live in a country where wood is difficult to be had, can form any idea, of the situation of the people, where that essential article is not to be met with†.

In the neighbourhood of great towns, and of the metropolis in particular, woods are not to be encouraged, being nurseries for thieves; and because the ground, in such situations, can evidently be more profitably employed.

3. As to soils, peculiarly adapted for the culture of corn, even there, by a judicious planting round the borders of arable fields, or of corners, liable otherwise to lie waste, much timber may be raised, that would be equally adapted to house and ship building. The profit of plantations, on the borders of fields, is very great in Flanders‡, and, though the vicinity of wood is not favourable to the production of corn, yet the shelter it affords, improves the climate, prevents evaporation, and the moisture it occasions, greatly promotes the growth of herbage.

* In the Cotswold Hills in Gloucestershire, from the want of wood, they are under the necessity of using straw as fuel, thus destroying the fertility of their arable land. *Turner's Report of Gloucestershire*, p. 54.—In the Staffordshire Report, p. 98, note, their earthenware could not be sent out of the country, unless packed up in *crates* or baskets. Coal mines without wooden props could not, in many cases, be worked.

† The inhabitants of the Hebrides, for instance, have to undertake a dangerous voyage, of from thirty to seventy miles, before they can build a barn;—or make a plough, even of the rudest construction;—or procure a flail; or even the handle of a spade. This want of timber, distresses the people in their houses, in their husbandry, and in every art.—*Dr. Walker's Economical History of the Hebrides*, p. 207.

‡ Analysis of the views of "Improved Agriculture, &c." by F. Vanderstraeten (a Flemish author), p. 18. In Britain, proprietors generally receive the value of the soil cultivated, in 25 years, by annual instalments; but in Flanders, the plantations round their fields, will yield, it is said, the value of the cultivated, as well as planted soil, in 40 years.

The remaining points to be considered in this Section are, 1. The different sorts of natural wood, and their management; and, 2. The various kinds of plantations, their mode of management, expence attending them, &c.

1.

Of Natural Woodlands.

Natural woodlands are divided into four sorts: *coppices* containing underwood merely;—*mixed woods*, consisting both of timber and of underwood;—*groves*, which contain nothing but trees;—and *forests*, or extensive tracts of country, covered with large timber and bushes.

1. *Coppices.*

It is not usual to have woodlands entirely copse; as it is considered more advantageous, to have wood of various sizes, so as to suit all kinds of customers. In this way, it is disposed of with more advantage to the owner, and more convenience to the neighbourhood. The small wood is used for laths, baskets, hedge-stakes, puncheons for coal-pits, &c.; those of a larger size, for husbandry implements of every description; while the largest timber is employed, in the construction of houses, and the building of ships*. At the same time, in some districts in England, no standards, or saplings, are reserved. It is laid down as a maxim, "that small gains, and *quick returns*, make the dealer rich; but that long credit ruins him." It is a rule, therefore, with that view, to cut down *the whole coppice* as soon as it is saleable. The loss of the interest of the money, and the damage which the underwood receives from the drop of the standards, are favourable to this system†.

The principal points to be attended to, in the management of coppices are, 1. Fencing; 2. Draining; 3. Shelter; 4. The age of cutting down; 5. The season of the year for performing that operation; and, 6. The application or uses.

1. *Fencing.*—The enclosing of coppices, is the most essential of all particulars connected with their management.

* West Riding Report, p. 123.
† Wilts Report, p. 89. Derbyshire Report, vol. ii. p. 221, 228, 315.

A landlord had better admit cattle into his wheat field, than into his underwood. In the one case, they only injure the crop of one year, whereas in the other, by biting and mangling one year's shoot, mischief is done to the amount of at least three years' growth. By the bite of cattle, there is a peculiar injury done to the growth of wood, the irregularity of the incision, bruising and lacerating the plant. At five, or even six years of age, the young shoots are neither high enough to be out of the reach of cattle, which eat them greedily, nor strong enough to resist their weight, when they press upon them, in order to reach the succulent buds on the top. When oak woods are eaten, or cropt by cattle, they will never thrive, until they are cut over at the ground, and where the injury has taken place, the sooner it is done the better*.

Great mischief has been done to many thriving woods in England, from their being subject to common rights of pasturage for cattle, and in some instances, of deer; in consequence of an idea, that cattle or deer do little injury to woods, after they are seven years old. But it may be remarked, that if the owners of such woods, saw this injury in its proper light, they would not hesitate to make ample compensation to the commoners, to induce them to abandon such rights of pasture†.

While in a state of commonage, the young plants that spring up spontaneously, are so much exposed to injury, that few of them will come to perfection‡.

Mr. Davis calls the stools, that produce coppice wood, *under-ground pollard trees*, which have their youth, their perfection, and their decay. During the first and last stages of growth, they are particularly susceptible of injury, and if the wood is constantly cropped, it will ultimately perish.

Sheep, are likewise considered to be destructive, as they frequently rub against the trees.

Horses are not apt to do so much mischief as cattle, unless they are pressed with hunger; but hogs do the least injury, and where acorns abound, this species of stock, are the most profitable. At the Conquest, woods were valued, not by their quantity of timber, but by the number of swine their acorns would maintain§.

2. *Drainage.*—Oak timber always flourishes best in woods moderately moist, rather than in those that are wet. Where

* Berkshire Report, p. 240.
† Wilts Report, p. 84.
‡ Wilts Report, p. 85.
§ Sussex Report, p. 165.

woods therefore are wet, they should be drained, by open cuts, because the roots would soon disturb and stop up covered drains. This is now, in some cases practised, and is found to be as profitable in respect of woods, as in arable land. Where that plan is not adopted, the willow and the sallow ought to be multiplied. Attention to draining, would prove highly beneficial, in the wet heavy woodland counties, and greatly promote the growth and durability of oak and other valuable timber*.

3. *Shelter.*—The great object, in the management of coppice is, to accelerate the growth. It makes an immense difference, in point of profit, when a coppice can be cut in twelve, instead of twenty-four or thirty years. The slowness of the growth, is either owing to injury done by cattle, or the native coldness of the soil or climate (which may be improved by draining), or is occasioned by exposure to the violent south-west winds. This, however, may, to a certain degree, be obviated, by skirting the wood, according to the nature of the soil, with Scotch fir, Spruce fir†, and other hardy plants; and a moderate quantity of timber, may likewise have the effect, of screening the underwood from the severity of the blast.

4. *Period of cutting down.*—Customs vary, as to the number of years' growth, at which coppices ought to be cut, from 9 to 27 and 30 years. It must depend on the rapidity of its growth, and the uses to which it is to be applied. In favoured situations, a growth of twelve years is considered to be sufficient; but in many instances, underwood cannot, by the best management, be made worth more than 8*l.* per acre, at 16 years' growth. Twelve small oaks, however, per acre, worth 20 shillings each, may be cut regularly at the same time, which renders the total produce 20*l.* per acre every 16 years‡. The great wood proprietors in Scotland, generally cut their oak coppices from 20 to 24 years, and it is sometimes extended to 30 years. The principal object in that country is the bark, which is considered to arrive at its greatest perfection, at the age of between 20 and 30 years. *Under* that age, at least in the climate of Scotland, its virtues are weak; *above it*, the bark becomes coarse, and loses its sap§.

5. *Season for cutting down.*—There are many opinions,

* Vancouver's North-East Essex, p. 32. Young's Calendar, p. 33.
† Derbyshire Report, vol. ii. p. 264.
‡ Somerset Report, p. 230.
§ General Report of Scotland, vol. ii. p. 81.

respecting the proper season of the year, for cutting underwood, but there is one rule, which, for the advantage of the seller, should be steadily adhered to, namely, that the older the wood is, the later in the spring it should be cut. When old wood is cut early in the winter, and a severe season follows, the damage done to the old stock, and to the standards, is very great. On the other hand, it is supposed to be for the interest of the buyer, that all wood should be cut in the most stagnant state of sap, as being, in that case, more durable; and in all cases where bending is required, such as hurdles, hoops, and even dead hedges, the wood cannot be cut too early in the winter, for if cut when the sap is rising, it becomes brittle, and unfit for those purposes*. With regard to seasoning timber, there is a difference of opinion, at what period timber should be felled. But as the value of bark is considerable, the spring, on the whole, is the most profitable to the owner.

6. *Application and Uses*†.—It is well known, that in an oak coppice, the principal profit is derived from the bark, and that sometimes, at 16 years' growth, when the wood fetches only 6*l.* for charcoal, the bark will produce 15*l.*‡ The wood of coppices, may likewise be converted to various minute purposes. Charcoal was formerly a great means of consumption§, but since the practicability of employing charred pit-coal, in the manufacture of iron, that is no longer so great an object, and the charcoal of wood has considerably gone into disuse. In some districts, as in Sussex, the brushwood is employed with great advantage, in the burning of lime. Fortunately also, a new mode of using the small wood of oak, &c. has been discovered, namely, that of extracting from it, a liquid pyrolignous acid, in considerable quantities, for the use of the manufacturers of dying and printing colours, and for various other purposes. The extreme twigs and buds of the oak, may likewise be used in tanning‖.

* Wilts Report, p. 89.

† Mr. Davis, Wilts Report, p. 86, enumerates the various purposes to which young trees are applied, as *Ash poles*, for sheep cribs, rind hoops for barrels, rigging for ships, &c. *Hazel*—Sheep hurdles, spars for thatching, and pease and bean sticks, dead hedges, &c. *Alder*, *Willow*, *Birch*, &c.—Poles for rafters, pattens, clogs, shoe-heels, coal-pit uses, rails for fencing, &c. *Oak*—For hop-poles, where the culture of that plant prevails, &c.

‡ Preliminary Observations to the Westmoreland Report, p. 288.

§ It is still so about Wingerworth, Alderwasley, &c.—*Derbyshire Report*, vol. ii. p. 235.

‖ Cheshire Report, p. 326. Derbyshire Report, vol. ii. p. 339.—These twigs and buds are collected by women and children, and pressed into bags

2. *Mixed Woods.*

The management of woods, where there are both large trees, and underwood, though not without its difficulties, does not require the same degree of skill, or unceasing labour and attention, as the cultivation of arable land, or the management of live stock. It is principally necessary, that the woods should be properly fenced;—that they should not be damaged by the inroads of cattle or other stock;—that drainage, and other practical modes of improvement, should not be neglected;—that the wood should be divided into regular falls, or portions, so as to furnish an annual income, with as much certainty as arable land;—and that when sold, every pains be taken to procure their full value. By these means, and the reservation of an adequate share of large timber, the proprietor will generally have a safe, and perhaps an improving treasure at his command*.

In Scotland, it is the general practice of wood holders, to *reserve*, at every cutting, a certain number of trees, of the most beautiful and promising appearance, to become timber at a future period. At the first cutting, about the age of 24 or 30 years, between 3 and 400 trees per acre, are generally reserved. At the second cutting, when they are 48 years standing, the number is considerably diminished. They are still farther reduced when they are 72 years old, and the process is sometimes extended to a longer period, when timber is obtained of a considerable size, and applicable to various domestic and naval purposes. The abstraction of nourishment, and the droppings of a large tree, will, in a considerable degree, affect the young shoots in the neighbourhood; but the injury thus sustained, must perhaps be borne, because, in a public point of view, the possession of large timber is an object of national importance†.

The trees principally grown in woods are the oak, the beech, and the birch.

1. Some of the best English oak is produced in the Weald of Sussex, and underwood is there considered to be

when dry. They should be used early by the tanners, after being crushed under their rolling stones.

* Sussex Report, p. 182.

† Hence it is strongly recommended, as a matter of policy as well as justice, that higher prices for large timber, should be paid by the public, than heretofore has been usual.—*Derbyshire Report*, vol. ii. p. 225, 227, 315.

its best screen or nursery, contributing greatly to the growth of the trees mixed with it, by its shelter and protection. The standards in Sussex produce about 5*s.* per acre per annum; and the underwood, while it grows, at the same rate; which brings both to a par with the arable and grass land in the neighbourhood, as they rent at about 10*s.* per acre. But the trees, when they increase in size, do mischief to the underwood, and when the timber is left standing for 100 or 120 years, the underwood is effectually destroyed. Lord Sheffield sold 30 acres of wood for 1400*l.* or 46*l.* 13*s.* per acre, which divided by 100, when the oak arrives at perfection, is 9*s.* per acre per annum, besides the profit of the underwood, while it remained productive*. Some of the best thriving woods on the Petworth estate, yield of gross produce, at the rate of 20*s.* per acre per annum, and of net profit about 12*s.*† The profit from timber, however, in other places, was so inconsiderable, that the income produced, was less from woods, than from arable, or pasture lands, of similar quality: and this disproportion existed, though timber has increased, within the last 15 years, as 11 to 7, and bark, as 15 or more, to 8; and other articles, the produce of such woods, in nearly the same proportion‡.

In the neighbourhood of our naval arsenals, however, the case is now different. Formerly, while the Navy Board availed itself of the monopoly of large timber, which it in a great measure enjoyed, to keep down the price, it became a maxim with timber growers, on account of that debased price, that it answered better, for the sake of the quickness of the return, to cut down an oak, before it reached the value of 40*s.* or even 20*s.*§ than to suffer it to remain, till it acquired a large size. The highest price, 30 or 40 years ago, did not exceed five guineas per load: the same, or even inferior timber, has recently sold for 15*l.* per load. A good price being of late obtained, there is a much better prospect that oak timber will be permitted to reach a large size; and if a greater difference of price were allowed for timber of the

* Nine shillings per acre, per annum, for 100 years, payable at the termination of that period, is less than a rent of 4*d.* per acre per annum, payable every year. One shilling per acre per annum, in 100 years would amount to 130*l.*

† Sussex Report, p. 171, 172.

‡ Derbyshire Report, vol. ii. p. 226.

§ Ditto, vol. ii. p. 330.

largest dimensions, compared to those of inferior sizes, the growth of large timber would be essentially promoted. Under a proper system, therefore, it can scarcely be doubted, that Great Britain, could with ease furnish, the utmost quantity of oak timber, which can ever be required for her military and commercial shipping, without any material interference with other branches of land produce*.

2. In Buckinghamshire, the Chiltern districts of Oxfordshire, in some parts of Hampshire, and generally where the soil is chalky, or incumbent upon limestone, beech is the most abundant wood. In Buckinghamshire, they are *drawn*, or thinned annually, by certain portions, the young trees being left for succession, and the large single stems, at 30 or 40 years' growth, being cut down, sawn into lengths of about four feet, converted into billets for fire-wood, and conveyed by the Thames to the London markets. Good beech woods, on this system, will, it is said, pay about 20*s*. per acre, clear of all expences†. It requires some judgment to thin these woods, so as to prevent the standards from hanging too much over the young seedlings; and in southern aspects, to prevent the injury that may take place, if the soil is too much exposed to the sun‡. Mr. Fane of Oxfordshire, pays great attention to the training of his beech trees, to lead and keep them as erect as possible, that a spreading growth may not drip on and check the young succession§. The Bishop of Durham at Mongewell, possesses beech woods, which are managed on the thinning system, at 20 years' growth, and pay about as well as letting the contiguous arable land‖. The beech excels all other trees for producing great quantities of *mast*, which is an

* Sussex Report, Appendix, No. II. p. 469. It is said that a 74 gun ship requires 3000 loads of wood, the produce of 50 acres, each tree standing about 33 feet apart, which at 15*l*. per load, would be 900*l*. per acre. At one rod apart, the extent required would be twelve acres and a half. *Marshall on Planting*, vol. i. p. 112.—In the Memoirs of the Academy of Brussels, vol. iv. p. 263, there is an essay by M. De Limbourg Le Jeune, on the means of improving timber for the navy, which seems to merit attention. By previously barking the tree, it is said, that the whole timber it produces is thereby rendered equally firm and solid. But this is a point on which there is a difference of opinion. *Derbyshire Report*, vol. ii. p. 331.—The fact ought to be ascertained by accurate experiment. The American white oak is strongly recommended, as superior to every other for the wheels of carriages.

† Young's Calendar, p. 34.

‡ Oxfordshire Report, p. 224.—The north side of a hill, produces a better growth of beech than the south side; a proof of the hardiness of the plant.

§ Sussex Report, p. 222. ‖ Oxfordshire Report, p. 222.

article much relished by hogs and deer, and yields much oil, fit for various important purposes*.

3. In several districts of England and Scotland, there are extensive tracts of natural birch. They have a beautiful effect upon the scenery, and form a comfortable screen to increase the warmth in such situations; but the value of the timber is much inferior to that of oak, and the bark, though used for tanning leather, is much less powerful than oak bark†. The mode of extracting tar from the birch, particularly from its bark, which is found of such importance in Germany and Russia, has not yet been introduced into this country.

The rules for the profitable management of woods in general, are neither numerous, nor difficult to execute. The proprietor should fix on those sorts of trees, the most likely to be in demand;—he should have them examined at stated periods, that he may know what trees are increasing in value, what stationary, and what decreasing;—he should select such young trees as are best adapted to keep up a regular succession, so as to produce the greatest quantity of timber, on any given quantity of land, consistently with the growth, and comparative value of the underwood:—he should cut down such as are likely to obstruct the growth of the trees intended to be preserved;—and he should accurately ascertain, what period of their growth, is the best suited, for the markets to which they are to be sent, and the purposes of the consumer‡. By attention to these simple rules, property in wood may be rendered much more valuable than otherwise it would be.

3. *Groves.*

If profit is alone to be considered, trees, of every species, ought to be cut down, when the annual increase in value of the tree, by its growth, is less than the annual interest of the money it would sell for§; and the annual value of the land it grows on‖. But such is the inadequate price of large, and even middle sized timber, that it is still too much for the interest of the owner, to cut down even the finest oak, when it is worth 40*s.* than to keep it till it is fit for the

* Bucks Report, p. 256, note. † Inverness Report, p. 212.
‡ Buckinghamshire Report, p. 260.
§ Bishop Watson's Preliminary Observations to the Westmoreland Report, p. 290.
‖ Marshall's Review of the Northern Department, p. 225, note.

Navy*. Fortunately, however, for the naval strength of the country, there is nothing more ornamental for the seats of landed proprietors, than groves of thriving trees; and on that account, much timber is preserved, that would otherwise have been cut down.

But trees, at a proper distance from a manor house, are not only ornamental, *but useful;* if too near, they obstruct the free current of the air, and send forth great quantities of moist exhalations, which render it constantly damp. Thick woods, therefore, ought to be avoided, near a house, more especially in a flat country. At a proper distance, however, they are of service, from the shelter they afford against cold winds, and from the shade they yield against the heat of the solar rays.

The value of a grove likewise, is frequently very great. Mr. Davis states, in the Report of Wilts, the result of an accurate estimate of one acre of timber, in the grove at Longleat, (the seat of the Marquis of Bath), in April 1810. The aggregate value at that time, was upwards of 1500*l.*, and there were several single acres of equal value†.

4. *Forests.*

In several parts of Scotland, more especially in the counties of Perth‡, Aberdeen, Elgin, and Inverness§, there are extensive tracts, which naturally produce the Scotch fir *(Pinus sylvestris)*. This tree thrives to the height of 1400 feet above the level of the sea, and it has been remarked, that the timber which grows on the highest elevation, is of the best quality, and superior to any foreign timber that is

* Derbyshire Report, vol. ii. p. 330.

† Wilts Report, p. 91.—The acre, which was measured in the form of 16 perches by 10, was found to contain the following quantities of timber:

	Feet.		*Tons.*	*Feet.*
Nine oaks, measuring - - - -	2952	or,	73	32
Twenty chesnuts and abeles - - -	3182		79	22
Twenty-two small trees of various kinds -	280		7	
Total, - -	6414	or,	160	14

Being fully one ton of timber to a perch of land.

‡ In Perthshire, Col. Robertson of Struan, has a natural fir wood, that covers 2566 acres.—*Report*, p. 235.

§ The natural fir woods of Ross-shire, except one or two on the Balnagowan estate, are mostly exhausted.—*Report*, p. 204.

imported. Owing to the distance of these fir woods from good markets and water carriage, the profit they yield is inconsiderable. By a contract for cutting a pine and birch forest in Glenmoriston, which is of great extent, the sum to be paid to the proprietor, was only 800*l.* per annum, for seven years. The great forest of Glenmore, belonging to the Duke of Gordon, sold only for 10,000*l.** Nor have the forests of Rothiemurchus, nor of Bremar, though the latter contains 100,000 fir-trees in full maturity, of superior quality†, and many of them computed on an average, at from 150 to 200 cubical feet each, produced the sums that were expected. This is owing to their distance from the sea, and the expence of bringing them to market.

2.

Of Plantations.

On various accounts, plantations merit particular attention. Besides answering the purposes of natural wood, for all the important objects for which that substance is applicable, planting is perhaps the only improvement of which, in many cases, extensive tracts are susceptible. Several sorts of trees also, may thus be introduced, which, though not indigenous, will, under proper management, thrive in a country. In this way, likewise, the climate is improved, by the shelter thus obtained; and the beauty of the scenery is heightened, by covering barren rocks, and bleak heaths, with the verdure of woods.

It is certainly a fortunate circumstance, that, with the exception of very high mountains, there is scarcely any portion of land, so poor, barren, rocky, or unproductive, as not to admit of this species of improvement, provided trees, suited to the quality of the soil, and the nature of the climate, are selected, and the proper modes of treating them are practised. But though there are inducements to plant, yet, unless in places where the demand is great, trees should

* It was the trees that exceeded a specific circumference of bole, which were by this contract to be felled. Since that was done, the younger wood has made a great advance.—*Moray Report*, p. 291.

† In the upper parts of Aberdeenshire, the fir timber is of slow growth. It appears, in many cases, to be above 100 years old, and sometimes about 230 years, from the number of concentric circles near the root; and it is considered far superior to any timber ever imported from Riga, Memel, or any part in Prussia, or Norway.—*Aberdeenshire Report*, p. 372.

not be reared in any quantity, upon land that may be made subservient to agriculture or productive pasture. Crops of grain, or herbage, will, in general, produce a much more expeditious and more profitable return*.

Before a plantation is begun, the following points ought to be considered: 1. The manner in which young plants ought to be raised;—2. The trees best calculated for several soils and situations;—3. The manner in which they ought to be planted;—4. The expence of planting;—5. The mode of management;—and, 6. The probable profit.

1. Some have maintained, that it is better to raise the young plants in a nursery, than to sow the seed in the ground where the trees are to be raised. The late Mr. Davis, author of the Wiltshire Report, whose skill and experience were doubtless considerable, contended, that where the oak was well managed, it would be bigger and taller at seven years old, when raised in the nursery, and its tap-root cut, than one uncut would be at ten†. Strong objections, however, have been urged against the using of plants, raised in at least public nurseries, and more especially against the cutting of the tap-root.

Young trees should always be raised on good land, so as to carry a stock of health and strength with them from the nursery. They are thus furnished with abundance of roots, by means of which they are enabled to find nourishment, even in poor land, having more mouths to collect it. This doctrine, originally inculcated by Miller, the father of English gardening, is now almost universally admitted.

It is a material object, that the roots should have the means of growing without obstruction. In stiff heavy clays, therefore, it is considered an advisable practice, to trench the ground two spits deep the year before the ground is planted, though at an expence of about 8*l.* per acre. But light land requires no digging‡.

2. The great variety of trees to be found in nurseries, puts it in the power of a planter, to procure a species calcu-

* Where the soil is thin and barren, trees should be sown, as the tap-root finds more nourishment from the subsoil; but if the soil is wet, and pretty deep, it is much better to plant them.—*Shropshire Report*, p. 212, 214.

† Wilts Report, p. 94.

‡ Wilts Report, p. 96. Young plants, digging holes, planting, and protection, may be stated at 10*l.* per acre, the interest of which is 10*s.* per annum. In 100 years, the timber and underwood, if the plantation succeeded, might sell for 130*l.* That is not 26*s.* as is generally supposed; for one shilling per acre, per annum, would amount to 130*l.* at compound interest, in 100 years.

lated for his soil and climate, or for the situation in which he may happen to be placed in regard to market. The various sorts may be considered as adapted, 1. For elevated grounds;—2. For steep lands unfit for cultivation;—3. For low and moorish tracts;—4. For swampy grounds or bogs;—5. For the sea-coast;—and, 6. For lands of rather a superior quality.

1. *Plantations on Elevated Lands.*—When judiciously raised, plantations on elevated lands, are productive of the most beneficial effects. By the warmth which the shelter of trees occasion, heath is destroyed, and the growth of better herbage is promoted. The grasses which are thus brought forward, are sometimes three weeks earlier in spring, are better in summer, and protracted for three weeks longer in autumn*.

The trees that thrive best in an elevated situation, are, the larch;—the Scotch pine or fir;—the mountain ash;—and the birch.—In a medium elevation, the beech may likewise be cultivated.

The *Larch (Pinus larix,* Linn.) †—The introduction of this species of tree into the British Isles, is, perhaps, the most important acquisition, in respect to timber, in modern times. The larch adapts itself to a variety of soils and exposures; while the wood it furnishes is of the best quality, even though raised in elevated situations, and on a soil not very rich. It will thrive at the height of 1200 feet above the level of the sea, and even higher. The wood is closer in its pores, and has fewer large knots than the Scotch fir. It is a more beautiful tree, vegetates more rapidly, and grows in situations where the Scotch fir cannot be raised to any advantage. Its wood can resist the effects of being alternately wet and dry, better than any other tree, except perhaps the elm, hence it is well calculated for sub-aquatic purposes ‡; it is peculiarly fitted, from its property of burning with difficulty, for various important uses in architecture; its bark possesses in a high degree, the tanning principle; its growth is so rapid, that if the ground be tolerable, it becomes in

* Lord De Vesci finds, if the grass cannot be cut for soiling, that it is the best plan to tether the stock in woods and plantations.

† There are four sorts of larch, but the common white larch *(Larix pyramidalis)* is the best entitled to attention, where it will thrive.

‡ The larch is peculiarly calculated for gate-posts. They have been found to remain, for at least eleven years in the ground, as sound and perfect as when cut out of the tree. *North Riding Report*, p. 189.—The Rev. Mr. Hoblyn found them rather more durable than even the oak.

thirty years, fit for various household and other purposes*; it is well adapted to mill-work; and in ship-building, may be used, as a substitute for oak†. It is said also, that the larch, from the droppings of its leaves, will, in the space of a few years, convert a barren heath, into grass land, worth from five to ten shillings per acre.

In some instances, the larch is liable to a disease, and its leaves are destroyed by insects, more especially in low and damp situations. By some, this disorder is attributed to want of circulation of air, from their being planted too close together. Where they stand bold and single, they are not liable to it. Others ascribe this circumstance to the present practice of raising plants, from the seed of trees that had not arrived at their full maturity, and sometimes even from layers which strike root. It is not improbable that the larch, originally introduced from the mountains of Carniola, will at length degenerate with us, at least as to perfecting healthy seed. Hence it would be advisable, to import annually, at least a portion of the seed used in our nurseries, from the Alpine regions.

The *Scotch Pine, or Fir, (Pinus sylvestris,* Linn.*)*—This tree is well calculated for peculiar situations. It thrives on the thinnest and driest soils; on the poorest exposed moorish ground, if not too wet, or overgrown with rein-deer moss; and may be planted successfully, wherever there is short heather, growing above gravel or sand; on sandy heaths near the sea shore; and on mossy soil, less than two feet in depth, but bottomed with gravel, and not clay. It must have a subsoil permeable to water, and hence a clayey bottom is fatal to it. It thrives to the height of from 1000 to 1200 feet above the level of the sea, and its timber improves with the increased height of its elevation; but high winds are very destructive to this tree, and a fall of snow will destroy, or greatly injure, in the course of one night, sometimes one-third of a fir plantation‡.

The timber of this tree is made use of, for several architectural and agricultural purposes. It produces a variety of useful substances§, and though not so profitable as the

* Derbyshire Report, vol. ii. p. 252.

† Observations on the Larch by the Duke of Atholl.—*Communications to the Board of Agriculture,* vol. vii. p. 273.

‡ Communications to the Board of Agriculture, from the Duke of Atholl, vol. vii. p. 276.

§ Lambert, in his description of the genus *Pinus*, enumerates ten distinct substances, as turpentine, tar, pitch, lamp-black, &c.

larch*, yet it possesses several advantages: it grows fast, and the wood is of sufficient use for farm-houses. The fir cones, and decayed wood, furnish the poor with fuel. The green boughs keep deer completely well in winter; and they save much hay, if given to sheep, in snows; the boughs are likewise of great use as firewood, in fences, &c.† To this may be added, its utility in ship-building: a very fine frigate of 800 tons, the *Glenmore*, being entirely built of Scotch fir, except the masts. The late Mr. Davis of Longleat, was partial to this tree. He observes, that firs not only grow faster than forest trees, but that four firs will stand and thrive on a space of ground, which one oak will require; and that it is greatly preferable, to see a barren heath, even in the summer, covered with a grove of thriving Scotch firs, than with a parcel of half-starved stunted trees of any other description‡.

One of the most important uses for which this tree is at present employed, is as nurse or shelter to young plantations, in which it is the object to rear more valuable timber. In this case, it is necessary gradually to weed out the Scotch fir, so as to furnish the trees, of which the plantation is finally to consist, with the proper supply of air and sun.

The *Mountain Ash* (*Sorbus aucuparia*, Linn.)—This tree will grow at an elevation of about 2000 feet, and as it thrives well in dry and rocky soils, it is well calculated for exposed and elevated situations, and may be advantageously employed for the purposes of shelter. It is much cultivated of late in pleasure-grounds, on account of the beauty of its foliage, its flowers, and its fruit. The wood is of use where a hard and compact substance is required; and its bark possesses a considerable degree of the tanning principle, and leaves the substance tanned, more soft and pliant than the oak.§

The *Birch* (*Betula alba*, Linn.)—This tree is the natural decoration of a northern clime. It has been found growing naturally more than 1500 feet above the level of the sea.

* The Duke of Atholl, sold a larch of 50 years old, for twelve guineas. A fir of the same age, is only worth fifteen shillings.—*Communications to the Board of Agriculture*, vol. vii. p. 276.

† Lincolnshire Report, p. 245.

‡ Papers of the Bath and West of England Agricultural Society, vol. x. p. 312.

§ There is reason to believe, that all the finer branches of tanning, ought to be done by the bark of the mountain ash, the birch, or the willow tribes, in preference to the oak. Fishermen greatly prefer having their nets barked first with these materials, and afterwards with oak bark.

It will thrive almost any where, but succeeds best in a light dry soil; and bears better than any other tree, the severities of a northern climate*. It is useful to the turner; in various kinds of machinery; for underprops in coal-pits; and in making sleepers for rail-ways. A species of excellent vinous liquor has likewise been made from the birch†. But its most important use has hitherto been too much neglected in this country. It is the bark of the birch tree that produces that glutinous, odoriferous, and inflammable gum or oil, which the Germans and Russians employ in tanning leather, and which gives it that peculiar odour, so hostile to insects‡.

The *Beech* (*Fagus sylvaticus*, Linn.)—This is a hardy tree, and will thrive in moderately elevated situations, particularly in calcareous soils, as chalk hills and downs, as well as in deep and sandy loams. It will likewise grow among limestone rocks, where soil is scarcely visible. The timber is valuable for husbandry purposes, and for various kinds of machinery. It is also peculiarly well fitted for water-works of all descriptions; and it is used for the keels of ships. It is much employed in making chairs, bedsteads, and other articles of furniture; and lately, as piles and planks for the foundation of Waterloo-bridge. It is remarked, that hardly any species of herbage will grow under beech.

In regard to plantations on elevated lands, it is to be remarked, that it is of great importance to plant them younger than is usually the case.

2. *Plantations in Steep Banks.*—The sides of hills, and banks of rivers, so difficult to cultivate, cannot be more advantageously occupied, than by trees. On the sides of hills, the ash and the sycamore, which have large resinous buds, and make large unpliable shoots, not liable to hurt or molest each other in the spring of the year, while they are tender, are the most likely to prosper; and more especially, if the situation be exposed to the south-west wind. In many parts of Gloucestershire and North Wiltshire, the profit made by planting *ash* and *willow* for underwood, on the

* Mirbel's Lecture, p. 45.

† Birch wine is made in Derbyshire, with the assistance of coarse sugar and raisins.—*Report*, vol. ii. p. 216, where the process is described. The most advantageous period for collecting the sap, is immediately before the leaves have expanded.

‡ This oil would be peculiarly calculated, mixed with butter or grease, for smearing sheep, and a small quantity of it would be sufficient.

cold and boggy soil of the sides of hills, is almost beyond credibility*.

3. *Low and Moorish Tracts.*—The birch, the alder, and the willow, are well calculated for such soils: but there is reason to believe, that the *pitch-pine* of America would surpass every other tree in such situations. The largest trees of that species in Scotland were all planted, *by accident*, in wet ground, or swampy spots, abounding with springs. No tree is more profitable. It is by nature much smoother in its texture, and freer of knots, than the Scotch fir. The quantity of turpentine in the wood, prevents its being injured by wet, and renders it well calculated for decks of ships, dressers, weavers' looms, and other implements. It also resists the dry rot in joists and rafters: as it *never splinters*, it might be of great use in naval architecture.

The ash is also raised to advantage in damp situations, and will grow healthy and luxuriant on almost any soil, even upon low, moory, swampy spots, upon a level with the water; nay, will vie on osier-beds with the aquatics†. That the ash will thus thrive in such situations, is a circumstance of considerable importance, and not so generally known as it ought to be.

4. *Swampy Grounds, or Bogs.*—Trees that spread their roots on the surface, as Scotch fir and larch, also birch and poplars, and, according to recent experiments, the ash, are to be preferred on such grounds. Oaks, and other trees with a tap-root, which strike deep into the ground, will not answer, for the roots of no tree can live in the lower parts of deep bogs, owing to the moisture they retain. The antiseptic quality, so universally to be met with in bogs, and which is so hostile to vegetation, ought first to be destroyed, by exposing the ground to the influence of the atmosphere, and mixing with the soil, some lime, limestone gravel, and other calcareous matters. Drainage, likewise, must not be neglected‡.

* Davis of Longleat's Essay on Planting; Papers of the Bath Society, vol. x. p. 311.—Mr. Davis states, that eight pounds per acre, per annum, have been actually made of plantations of this description in the neighbourhood of Highworth, on land not intrinsically worth 10*s.* per acre for any other purpose. Such respectable authority cannot be questioned, however astonishing the circumstance may appear.

† Marshall's Norfolk, vol. ii. p. 71. See also Wilts Report, p. 98.—Every farm should have as much ash, and other trees, as will supply it with hurdles. —*Bucks Report*, p. 254.

‡ See Appendix to the Second Report of the Select Committee of the House of Commons, on the State of Disease, &c. in Ireland, printed an. 1819,

This description of soil, also, may be rendered highly valuable, if planted with willows or osiers. A statute acre will contain about 20,000 stock plants, at eighteen inches distant from each other, and if six shoots grow on a stock, the amount is 120,000, which, at 10*s.* a thousand, the price given for them by the Commissioners of the Victualling-office at Deptford some years ago, would produce 60*l.* per statute acre. It is stated in the Ayrshire Report, that when the willow grows well, the shoots are ready for the market in three years, and will frequently sell for 24*l.* per acre. In eight years, the clear profit of an acre of the basket and coopers' willows, after paying rent and other charges, has amounted to 38*l.** The profit from planting willows on the islands in the River Thames, is great, but the real amount cannot be ascertained†.

5. *Plantations on the Sea Coast.*—The difficulty of raising plantations on the sea coast, is well known. The land on which trees may be grown, might perhaps be more profitably employed for other purposes; but such is the advantage *of the shelter thus given to the neighbouring fields*, that it is of the greatest importance to remove the obstacles, which have hitherto prevented the growth of trees in such exposed situations. Experience has shewn, that there are some species of trees better calculated than others, to resist the blasts of the ocean.

The *Pinaster*, or *pine-maritime*, is considered as peculiarly adapted for maritime situations; and the valuable property it possesses, of resisting the gales of the Atlantic, was fully ascertained by the late Earl of Galloway, who planted some of them almost on the sea beach, which have become large and flourishing trees‡. In Nova Scotia, the Weymouth pine *(Pinus strabus)*, has been observed to withstand the rigour of the sea-blasts, better than any other tree. The late Dr. Anderson ascertained, that the *Laburnum* will stand the sea-blasts, and shelter other trees; but it must be protected from hares, which are fond of its bark§.

The Huntingdon willow, next to the pinaster, seems best calculated to withstand the baleful influence of the westerly winds on the sea-coast. It is cultivated at little expence, and grows faster than any other tree. Its wood and bark

p. 141 and 148. The roots of the ash had not gone down, but had grown quite on the surface, appeared uncovered on the sides, and were coated with a strong bark. *Ditto.*

* Cornwall Report, p. 102.

† Middlesex Report, p. 280.

‡ Galloway Report, p. 173.

§ Aberdeenshire Report, p. 377.

are likewise of considerable value. In 28 years, this species of willow has been known to rise to the height of 58 feet, with a large trunk. A belt of this willow, opposed to the south-west, would form a speedy and effectual screen*.

There is a particular species of oak (an evergreen called the *Quercus virens*, or live oak), which abounds chiefly in the southern states of North America, which might thrive on our coasts, as the sea-breeze is said to be favourable, if not indispensable to its full growth†.

An isolated fact is mentioned, that a yew tree grew on a sea cliff, in the stormy island of Bernera, one of the Hebrides, which, when cut into logs, filled a large boat‡. The seed was probably brought there by a bird. It would be a most important discovery, if the fact were ascertained, that yews would grow in such exposed situations, for under their shelter, other trees might be raised.

The plane or sycamore, is likewise an excellent defence against sea-storms. It is less affected by the blast than almost any tree, and is upon that account, well fitted to form a screen of defence against the sea-breeze. It has been remarked, that both the ash and the common sycamore have large resinous buds, and that their shoots, though large, are not liable to injure, or to lock each other, in the spring of the year, when they are tender; and thence are the best adapted for exposed situations§. The ash thrives well near the sea, on account of the lateness of its foliage. The oriental and occidental planes, however, are extremely tender, and a few years ago a number of them were blasted to the west of London.

The *Tamariska Gallica* thrives rapidly in situations most exposed to the blast of the sea. It makes an excellent hedge, and, in seven years, has grown from ten to twelve feet in height, and feathered to the very bottom. It thrives well even about the Lizard in Cornwall, and there cannot be a more exposed situation‖. It does not however stand frost well, and on that account, the *Tamariska Germanica*, being a hardier shrub, ought to be preferred in the bleaker situations.

But if every other plant were to fail, *the flowering Elder (Sambucas Nigra)* would be found capable of resisting the influence of the sea. It may be used as a nurse to protect

* Dr. Walker's Hebrides, p, 261.
† Memoirs of the Caledonian Horticultural Society, vol. ii. p. 378.
‡ General Report of Scotland (Appendix), vol. iv. p. 466.
§ Wilts Report, p. 98. ‖ Cornwall Report, p. 49.

other plants from the sea-spray and the storm. Cuttings of it will thrive in the sand of the sea-shore, and will grow rapidly, particularly if the bottom be moist.

The difficulties, however, attending the raising of forest and even fruit trees on the sea-coast, have been surmounted by a simple expedient. There is reason to believe, that the neighbourhood of the sea is unfavourable to the growth of timber, not so much owing to the spray, as to the violence and frequency of the wind, more especially when the plants are young; for whenever shelter from the wind is afforded, the trees grow equally well on the sea-coast, as in the more inland districts*. Impressed with these ideas, the Rev. Mr. Formby of Lancashire, adopted the plan of sheltering the young plants from the winds, by raising sods round them, and guarding their tender shoots from the wintry blasts, until they had taken firm root in the ground. By this means, he has successfully planted some acres of land with forest trees, which are flourishing and ornamental to the country; and has succeeded in raising plantation and fruit trees so near the sea, that it was hardly thought practicable, till he had effected it†.

6. *Plantations on Land of rather superior Quality.*—On soils entitled to that description, the oak, the ash, the Spanish chesnut‡, and the elm, deserve the preference.

The properties of the oak, in regard both to the bark and timber, being so generally known, it would be superfluous here to speak of them. The timber of the oak, is acknowledged to be the most durable of any wood this country produces; for in many ancient buildings, it has remained uninjured, after six or seven centuries have elapsed. Deep clay, or loamy soils, therefore, where they are of too cold a quality to be well adapted for arable culture, cannot be better occupied than in the production of oak.

The ash seems to be entitled, in point of importance and of use, to rank next to the oak§. In size, as well as in

* Walker's Hebrides, p. 196, &c.

† Holt's Lancashire, p. 84 and 85.

‡ This tree is the best substitute for the oak, and grows remarkably quick in loamy and clayey soils: for ship-building, it is inferior to the oak, but for most uses, it is equal to that tree, and in buildings and out-door work, it is much superior. If it gets old, the timber is apt to get brittle. It should therefore, be cut, when the tree is in a growing and healthy state—*Kent's Norfolk*, p. 94 and 222.

§ Mr. Saville of Bocking, in Essex, planted five acres of moory land, 14 years ago, with ash, and they have thriven so greatly, as to promise to be the most profitable crop on his whole farm.—*Young's Essex*, vol. ii. p. 148.

beauty, a full grown ash is one of our finest trees. Its foliage, though late in appearing, (which is favourable to its success near the sea), and early in falling off, is peculiarly elegant*. Unfortunately the ash is particularly injurious, if planted in hedge-rows, to land when under cultivation. It is likewise unfavourable to the dairy, as its leaves often get mixed with the pastures of cows in autumn, and communicate an incurable bad taste to their milk, and the butter made from it. Hence the propriety of raising the ash in woods, instead of hedge-rows†.

The elm is a valuable tree. It makes good shelter; its shades do little harm to hedges, and neither its leaves nor its roots do any injury to grass, or to arable lands‡. Its timber answers various useful purposes, and by many it is considered equally profitable as the oak; for though the same quantities of timber from the oak and elm, are in value only at the rate of from two to three, yet the growth of the latter usually, is to the former, as three is to two; consequently they are, in point of value, on the same footing§.

There are also, some other trees, which, though of a subordinate character, may be turned to a good account; as the *Salix cœrulea*, or the French willow. The *Populus monilifera*, or the Canada poplar; also, *the wild cherry*, which ought to be extensively cultivated, as its timber, when of forty or fifty years' growth, is valuable for all building purposes‖.

3. There are various modes in which trees may be planted, each of which has its advantages. 1. Where the climate is bleak, and shelter is required, they ought to be planted in large masses; for though the outskirts may be stunted in their growth by wind-waving, yet the plantation will secure the growth of the interior, and principal part of it. 2. Belts of planting are likewise of great use. They oppose and break the current of winds, forming eddies, which are much softer and milder in their influence. By the shelter which they afford, the soil is ameliorated, and the produce is improved, even in districts naturally bleak

* General Report of Scotland, vol. ii. p. 205.

† Wilts Report, vol. ii. It is said, that an acre of very bad soil, steril red clay, and peat, in the space of 23 years produced ash trees, to the value of 115*l.* 10*s.* being upwards of 5*l.* per acre, per annum.—*South Wales Report*, vol. ii. p. 58.

‡ Wilts Report, p. 90. § General Report of Scotland, p. 90, 208.

‖ Dr. Rigby's Report of Holkham, p. 27. The black Italian poplar, when judiciously planted as a screen round barns, and farm-buildings, is said to be the most profitable for planting, of all the poplars.

and unfertile. The too frequent error in the construction of these belts is, that of making them too narrow. They should never be of less breadth than from fifty to sixty yards, except when the land is valuable, or the property circumscribed. When narrow, their effect in moderating the wind, may be greatly aided, by tall hedges. 3. In some districts small clumps are planted, which, if judiciously executed, are ornamental, and afford much shelter to a country bare of wood. 4. To plant the corners of enclosed fields, has of late been much recommended. The inducements to this plan are great. Two-thirds of the space are already enclosed, the angle cannot be conveniently brought under the plough, the soil is rich and in good order, and the beauty of the country is promoted; yet, if the corners are made very small, the enclosure of such spots, and the keeping of them in repair, is attended with considerable expence. 5. Planting the gardens of farmers and cottagers is practised on some estates, and has a good effect in point of appearance; but it is detrimental to the productions of the garden, and ought never to be attempted, where fruit-trees will grow. 6. Hedge-rows are highly ornamental; they give shelter, and in process of time, become timber; but unless properly managed, by judicious and high pruning*, they ruin the hedge, injure the adjacent grounds by their roots and shade, and when planted on the sides of roads, do great injury, by keeping them wet. (See Chapter III.) 7. Shade-trees, when judiciously planted in fields, are useful in hot weather, as a shade for cattle. The bird-cherry is the tree that bears transplantation at a much larger size than most others, and its wood is valuable. The beech, the sycamore, and lime, are likewise well calculated for that purpose. 8. Pollards do not seem to contribute much to ornament, and no other advantage is derived from them, except in districts, where fuel is extremely scarce†. Nor is cutting off the branches of trees in hedge-rows, making what is called a besom-head, to be recommended. It lessens the agitation produced by winds, and deprives the tree of what may be deemed its salutary exercise, while the loss of the branches, prevents it from receiving the nourishment it would otherwise derive, through the medium of the leaves they would produce‡.

* This is attended to in the Netherlands. See also Derbyshire Report, vol. ii. p. 259.

† General Report of Scotland, vol. ii. p. 277.

‡ Somerset Report, p. 127.

4. The expence of making a plantation, must vary according to the size and figure of the field planted; the kind of fence with which it is enclosed, the extent of draining which it may require, and the number, sort, and age of the trees of which they are composed. In Galloway the expence of planting by contract is 5*l.* per acre*. But on the whole, the following estimate is not too high, where thorough justice is done to the plantation, and where the trees are of a valuable description.

	£	s.	d.
Draining, - - - - -	0	15	0
Price of plants, - - - - -	3	10	0
Putting in, - - - - -	0	18	0
	£5	3	0

The expence of enclosing, varies from 10*s.* to 5*l.* per acre, according to the size and shape of the enclosure, and the materials of which it is made.

Though plantations may be done, therefore, cheaper by contract, yet being executed in a careless and imperfect manner, and frequently unthriving seedlings used, it generally fails; nor can any dependence be placed on the success of a plantation, unless all the necessary steps are taken with skill and attention. Draining, in particular, to which a contractor in general pays little attention, is essential. There are few species of trees that will thrive in a wet soil; and a large proportion of those cultivated in plantations, are injured or destroyed by superabundant moisture. Drains ought therefore to be made with peculiar care, and it is highly injurious to neglect them afterwards, and to allow them to fill up. If a plantation is worth the forming and fencing, it is surely worth the extra expence of making, and of keeping up drains, on which its future success principally depends.

5. Plantations are often made in ground encumbered with stones or rocks, where no preparation can be made,

* Galloway Report, p. 182.—On enclosing some commons near Poole, in Dorsetshire, about the year 1805, several hundred acres of miserable sand, covered with stunted heath, were sold freehold at five guineas per acre; and contracted to be enclosed and planted with 2500 forest trees, as well as supply the places of dead plants with living ones, and protect the whole for seven years, for another five guineas per acre.—*Communication from John Middleton, Esq.*

but pitting the ground for the plants; it is of use to dig the pits five or six months before the seedlings are inserted, the mould and even the turf being thus better calculated to nourish them. Where it is practicable, it is an expensive, but useful preparation, to trench or plough the ground before the trees are planted; and by some, cultivating roots, for two or three years afterwards, is recommended. The quantity of plants varies from 2000 to 4000 per statute acre, according to the bleakness of the situation, and the richness of the ground. A new mode of planting furze-fields has been tried in Sussex with success. After having produced for many years, so exhausting a crop as furze, the land is not fit for arable crops. The vacant places are, therefore, planted, principally with ash, and the furze cut out as the trees increase. Being found of little value for lime-kilns, the furze is spread out and burnt on land prepared for turnips, and the result is highly satisfactory, yielding excellent crops of turnips, without any other manure*.

Prejudices are entertained, against the mixture of different kinds of trees in the same plantation; but it certainly contributes highly to ornament, affording an endless variety of shade and colour; and gives the protection and shelter of the quicker growing, and hardier trees, to those which are tenderer, and of slower growth.

In managing plantations, the object is, to give, at the same time, a due proportion of shelter, and of air. In many cases, plantations, which have been well attended to in respect of *enclosing, draining, and properly planting*, have thriven well for the first 12, or 15 years, yet in 15 years more, the forest-trees have been ruined, by allowing the Scotch fir and larch, which had been judiciously planted for shelter, to remain for 25, or 30 years. The oak and the ash, have been partly destroyed, and what remains is, for want of air, so *drawn up*, and left in such a debilitated state, that though their oppressors be at length removed, they cannot support themselves; and the few that can stand, from the sudden transition which they have undergone, immediately stagnate, and become overgrown with moss†.

* Communication from Sir Charles M. Burrell, Bart.

† Too great a partiality for trees, often occasions an error, which defeats the object of the planter and improver. It is as necessary to thin trees judiciously, as to plant them with care and judgment; and yet it too often happens, that those who are *extremely* fond of planting, cannot reconcile it to their taste or judgment, to cut away trees that absolutely *injure* their

While the engrafting of fruit-trees has been found so advantageous, the same operation with forest-trees, has likewise been tried with success, and is certainly entitled to more attention than hitherto has been paid to it*.

6. The profit of a plantation must, in a great measure, depend, upon a number of local circumstances. The expence is immediate, and can be easily ascertained; but the returns are distant, and the planter is disposed to form too sanguine expectations for the future.

In Somersetshire, land not worth 3*s.* per acre, in a state of pasturage, has been planted with Scotch fir, which at 30 years old, were worth 30*l.* per acre†. Scotch firs planted in Galloway, on land of the same value, have been estimated worth from 24*l.* to 32*l.* per statute acre‡.

In Clydesdale, Scotch fir, planted on poor land, in the lower part of the county of Lanark, sells at from 20*l.* to 25*l.* per acre, at 25 years' growth, and at upwards of 80*l.* when it reaches 50 or 60 years§. But this is in the immediate vicinity of Glasgow, of the Clyde iron-works, and of many extensive manufactories.

Oak must always be valuable on account of the bark; but unless in the neighbourhood of large towns, of extensive manufactures, or water-carriage, the estimates commonly given, of the profit derivable from plantations, are in general exaggerated. At the same time, there is no mode by which poor soils can be more advantageously occupied; and stony or rocky land, cannot be so profitably employed, in any other way. Indeed on land properly situated, and calculated

plantations, and ultimately defeat their progressive improvement. Surely no person can dispute, that a grove, or plantation, consisting of trees well furnished with branches and rich foliage, is not a more pleasing and beautiful object, than if such trees presented an unsightly appearance,—of half dead and naked stems. Nor is it to be supposed, that trees crowded together, robbing each other of support, and of the invigorating powers of the sun and air, can arrive at a profitable growth? It is more absurd to be tenacious of cutting away young trees *when necessary*, than it is reprehensible, not to plant when it may be done with advantage.—*Communication from Edward Burroughs, Esq.*

* A respectable Scotch Judge, (the late Lord Polkemmet), grafted the English on the Scotch elm; and the service-tree on the mountain ash, and found it to answer. *West Lothian Report*, p. 244.—Grafting foreign, on English oak, has likewise been successfully tried in England.—*Marshall on Planting*, vol. i. p. 311.

† Somerset Report, p. 232.—Ten shillings annually for 30 years, would amount to 33*l.*

‡ Galloway Report, p. 182. § Clydesdale Report.

for that purpose, no speculation can be more pleasing, and, in some cases, more lucrative, than that of planting. The only objection is, the length of time required to bring it to perfection*. But this ought not to have much weight, as the benefit must accrue, either to the planter or his heirs; and where he has a numerous family, there is no means, by which its younger branches, can be more easily provided for†. If it be profitable, however, to plant new woods, it is certainly much more so, to protect those that are already planted; and to restore them from a state of decay‡.

On the subject of plantations, it is necessary to observe, how important it is, to discriminate between the different species of the same tree; since it frequently happens, that two or three distinct species, which require different situations, as to climate, have been occasionally confounded in the same plantation. This discrimination is effected, with much ability, in a work printed in the Memoirs of the Caledonian Horticultural Society§, in so far as regards the trees usually grown in Scotland. The advantages and defects of each species, are there pointed out; and hints furnished, by the adoption of which, the intelligent and public-spirited planter, may ensure the most essential benefits, to himself, and to his country.

Concluding Observations to Chapter IV.

Such are the various modes of occupying the soil, in a temperate climate, like that of Great Britain. It results from the whole investigation, that in such a climate, there is hardly a spot on the surface, except on the summits of bleak mountains, that may not be employed, to some purpose useful to man. Where the soil is capable of cultivation, valuable crops of grain, of artificial grasses, and other articles, may be annually procured from it; and even the

* On this account, it ought to be a favourite object with the apparent inheritors of estates, to turn their attention to the planting, pruning, thinning, and other improvements, of the property they are likely to possess.—*Derbyshire Report*, vol. ii. p. 339.

† Somerset Report, p. 128. ‡ Wilts Report, p. 87.

§ Entitled, "Report of the Committee for Experiments on the Naturalization of useful and ornamental Plants, under the Climate of Scotland," &c. &c. —*Drawn up by John Yule*, M.D. F.R.S.

most barren spots will produce, either profitable herbage, or some useful species of timber*.

* An experienced planter, (the Right Honourable William Adam), strongly recommends *the spruce* for a nurse, in preference to every other tree, for *the interior* of plantations, more especially for moist soils, and elevated situations. The silver fir is better calculated *for the outside*, being little apt, in that situation, either to wither, or to decay, and having a great capacity of resistance. In regard to the interior, in numerous instances, oaks, and elms, may be seen in his plantations, growing up, uninjured, in the bosom of spruces. This circumstance is easily accounted for. The deciduous trees above mentioned, send their roots downward, the oak in particular, which, the longer it grows, derives more of its nourishment from a depth. The spruce, on the other hand, spreading its roots along the surface, draws its nourishment from a different source. The spruce also, being thick-leaved, and its branches of a strong, and unpliable nature, gives much protection, and does little injury to its neighbours. Rising in a regular and pointed cone, it leaves full scope for the spreading top of the oak; while, being much feathered at the bottom, it protects that tree, or any other it is intended to shelter, from being windwaved. *General Report of Scotland*, Appendix, vol. ii. p. 476.—In soils and situations, where the spruce would grow but slowly, the Scotch fir is to be preferred as a nurse, as it will grow freely even in poor soils, is easier raised, and can be had at less expence.—*Remarks by Edward Burroughs, Esq.*

CHAP. V.

ON THE MEANS OF IMPROVING THE AGRICULTURAL STATE OF A COUNTRY.

" Agriculture is the great art, which every government ought to protect;—every proprietor of land to practise;—and every inquirer into nature to improve*."

Introductory Observations on the Importance of Agriculture.

THE prosperity of a nation, possessing an extent of territory, sufficient for maintaining its inhabitants, chiefly depends; 1. Upon the quantity of surplus produce derived from the soil, after defraying the expences of cultivation; 2. Upon that surplus produce, obtaining such a price at market, as will encourage re-production; and, 3. Upon the cultivator having such a command of capital, as may enable him to carry on his business with energy.

1. The surplus produce arises, from that inestimable quality possessed by the soil, which enables it, in proportion as it is skilfully managed, to furnish maintenance, for a greater number of persons, than are required for its cultivation. Thence proceed, the profits of the farmers;—the rents of the landlord;—the subsistence of the manufacturer, and merchant;—and the greater proportion of the income of the state. That surplus marketable produce, therefore, is justly considered to be, the main spring, not only of political power, but also of personal enjoyment. When that surplus produce does not exist, (unless in circumstances of a very peculiar nature)†, there can be no flourishing towns;—no

* See " Some Thoughts on Agriculture, both Ancient and Modern," printed in the works of Dr. Samuel Johnson, edit. 1806, by Murphy, vol. ii. p. 440. A modern writer compares agriculture to speech: " Agriculture, (he observes), " is an art which can live without all others, but no other " without it. This art is like speech, without which the society of men " cannot be preserved; the others, like figures and tropes of speech, which " serve only to adorn it." Another modern author denominates the productions of the soil, " The fountains of national wealth and independence; " and the source of individual prosperity and riches."—*Curwen's Report*, p. 1.

† Holland is commonly adduced as an instance in opposition to this doctrine; but even there, a considerable surplus of butter, cheese, and other

military or naval force;—none of the superior arts;—none of the finer manufactures;—no learning;—none of the conveniences and luxuries of foreign countries; and none of that cultivated and polished society at home, which not only elevates and dignifies the individual, but also extends its beneficial influence, throughout the whole mass of the community*. What exertions ought not then to be made, and what encouragement ought not to be given, to preserve, or to increase, so essential a resource, the foundation of our national prosperity!

In order to form some idea, of the amount of the surplus marketable produce, on very different soils, under a judicious system of cultivation, the following statements were drawn up, by two intelligent farmers, respecting that amount, in their respective occupations, the one possessing land principally clay, the other a light, friable and loamy soil, favourable to the growth of turnips.

Mr. Brown of Markle, in East-Lothian, occupies a farm of 670 English acres, on which, in consequence of almost all his servants being married, there is a population of 91 persons of all ages. Upon an average of years, the produce of 80 English acres is consumed on the farm, or given to the servants as wages, as nearly the whole of them are paid in grain, and have cows kept for their use, both summer and winter. About 90 acres are required for raising corn, clover, tares, and hay, for the working stock, and 45 acres to furnish seed corn. One hundred acres are in an unproductive state, that is, in summer fallow, or grass for young horses not employed in labour, and in fences, roads, stackyards, or devoted to purposes from which no direct produce is returned. Four acres are given to the servants, for raising flax, as a part of their wages; in all 319 acres; so there only remain 351 acres for raising surplus produce. Of these,

agricultural productions, is exported to other countries; and its power and wealth, principally arose from its extensive fisheries, and from its situation at the mouth of great estuaries, and large rivers, with a vast extent of continent behind it, which it supplied with goods. It was thus rendered particularly fit, both for the carrying on trade, and for general commerce.

* Malthus's Enquiry into Rent, p. 10.—An American statesman, has ably described the importance of agriculture in the following words:—"The faculty of cultivating the earth, and of rearing animals, by which food is increased beyond the spontaneous supplies of nature, *belongs to man alone.*—No other terrestial being, has received a higher gift than an instinct, like that of the beaver, or the ant, which merely hoards for future use, the food spontaneously furnished by nature."—See Mr. Madison's Address to the Agricultural Society of Albemarle, May 12, 1819; printed in The American Farmer, August 20, 1819.

about 120 acres are in pasture grass for sheep and cattle, in clover for soiling, or in turnips. This leaves 231 acres for raising disposable grain, the produce of which may be stated at nine hundred and fifty quarters, on an average of seasons. On the whole, he calculates, the surplus marketable produce of his farm, at eleven bushels and a fourth of corn, and twenty-four pounds and a half avoirdupois weight, of butchers' meat, for every English acre in his possession*.

Mr. Walker of Mellendean, in Roxburghshire, on the extensive tract of arable land he cultivates, (2866 English acres), with a population of 250 souls depending on its cultivation for subsistence, sends, of surplus produce, to market, 3551 quarters of grain, and 7000 stone of butchers' meat; or, ten bushels of grain, and thirty-five pounds averdupois weight of butchers' meat, for every acre in his possession†.

To these estimates of surplus produce, there are to be added, the hides, the skins, the wool, the tallow, and a variety of other articles, the basis of many important manufactures, the value of which, though it is impossible to give its amount correctly, from its great uncertainty, and the fluctuation of prices, must be very considerable.

If such are the beneficial effects resulting from cultivating of the soil, (and the facts are established beyond contradiction), what source, either of domestic industry, or of foreign commerce, can in any respect be put in competition with such a mine of wealth, when extended over a great empire‡?

* The following is the value of the surplus produce per acre in this case:

	£	s.	d.
11 bushels and a peck of grain of various sorts, at 8*s.* ...	4	10	0
Butchers' meat	0	7	0
Total	£4	17	0

† In this case, the value of the surplus produce per acre is:

	£.	s.	d.
10 bushels of various sorts of grain, at 8*s.*	4	0	0
Butchers' meat	0	10	0
	£4	10	0

‡ Montesquieu, observes, "that agriculture, that greatest of all manufactures, ought to flourish, before what we commonly call manufactures, take place as articles of trade and commerce; and after cultivation is at its height, those manufactures ought first to be encouraged, which work upon materials of our own growth; and, last of all, those which employ foreign materials."

2. But the prosperity of a nation, as already observed, depends not only on having a great marketable surplus, but also on its disposable produce, fetching such a price, as to encourage re-production. This was the case during the last war; and hence the nation was enabled, to persevere in it for so many years, and finally to bring it to a successful conclusion. By means of a great surplus of agricultural productions, sold at a high price, the farmer, and his landlord, were placed in a condition, to pay very heavy taxes to government;—to engage in improvements of every description;—to furnish employment to a numerous body of labourers, to whom the price of bread was of little consequence, while work was always to be had, at wages proportioned to the price of corn;—and to consume immense quantities of merchandize, and articles of manufacture, by means of which, those two branches of national industry were supported, when they were in a great measure deprived of foreign markets. History does not furnish an example of a nation, which *abroad*, made such incredible exertions, while *at home*, so many millions of people, enjoyed all the necessaries, the comforts, and most of them the luxuries of life; the whole originating in prosperous agriculture, without which, our manufacturing industry, our commercial relations, or the necessary operations of our finances, could not have been carried on.

3. Nor is it alone sufficient, that the farmer should have a price adequate to promote re-production: he should likewise have such a command of capital, (and if it must be borrowed, at a moderate rate of interest), as will enable him to carry on his business with energy. Indeed, where capital or credit is joined to skill in agriculture, it lays the foundation of general prosperity. It will not be disputed, that a hundred persons may be put to the greatest inconvenience, because one individual, *at the head of a chain of circulation*, cannot pay one hundred pounds. Enable him to pay that sum, and progressively, those connected with him are relieved. "But it is *the farmer* who is the first link, in the great chain of national circulation." When he is supplied with money, he is enabled to pay his rent regularly;—his landlord is thus enabled, not only to employ a number of labourers, but to purchase goods, from the British manufacturer, and the foreign merchant;—the latter finding thus a demand for foreign goods, is enabled, in return, to export British manufactures to foreign markets;—by means of an abundant circulation also, the revenue is

paid without difficulty, it is regularly remitted, and furnishes the means of paying the dividends due to the stock-holders; the credit of the country is thus maintained, and every class in the community prospers. The whole, it is evident, *originates with the farmer*, the first link, in the great chain of circulation, whose basis is the plough*.

The superior importance of agriculture, has been recently proved, in a manner so convincing, and unanswerable, that the question may now be considered as at rest. It is well known, that all the resources of the country were put to the test, by the strict manner, in which the tax on income was ultimately exacted†. By analysing, therefore, the produce of that tax, under all its several branches, the real foundations of our national wealth and prosperity, may be ascertained, with a degree of correctness, previously unattainable. The result of the inquiry is as follows:

1. Taxes on landed property		£4,257,247
2. Ditto, on the farmers, or occupiers, of land		2,176,228
Total agricultural classes		£6,433,475
3. Taxes on commercial property	£2,000,000	
4. Ditto on professions	1,021,187	
		3,021,187
Difference in favour of the agricultural classes		£3,412,288‡

* The superior influence of the farmer, in promoting national circulation, is as important a discovery in politics, as Sir Isaac Newton's, who first ascertained the principle on which the heavenly bodies circulated, was in astronomy. It is founded on the system of country banking, which ought to be encouraged, and placed on the securest possible footing. Those nations can alone be eminently, and permanently prosperous, whose governments will act upon that system.

† It is supposed by some, that the merchants and manufacturers, did not pay so high a proportion of their profits, as was paid out of the incomes of the landed interest. But this has always been denied by the parties themselves.

‡ It may be proper to state the amount of the income-tax, an. 1814, the last year that the assessments were imposed, under all its several heads:

		£
1. Agricultural classes as above		6,433,475
2. Commercial class		2,000,000
3. Professional classes		1,021,187
4. Tax on houses		1,625,939
5. Tax on the funds		3,004,861
6. Provincial offices	£188,932	
7. Naval, military, and civil establishment	924,312	
		1,113,244
Total gross amount		£15,198,706

The net produce was, 14,545,279*l.*, of which foreign commerce did not probably pay half a million.

Hence it appears, that during that eventful period, when the ignorant, and the prejudiced supposed, we existed solely by trade, and that we ought to be considered merely as a nation of *shop-keepers*, it was the wealth arising from the productions of the soil, that chiefly enabled us to go on; it was successful agriculture, that furnished us with the means of carrying on the contest, and of bringing it to a triumphant conclusion.

Nor is this subject to be dwelt on solely as a question of finance. Let it be considered, that it is the land which furnishes the raw materials of the greater part of our manufactures; that the proprietors and occupiers of land, are the best customers of our manufacturers and merchants; and that through them, the greater part of all other professions gain their livelihood. The fund-holders, also ought to be aware, that upon the prosperity of agriculture, the regular payments of their dividends must principally depend. *For it is to be observed, that as the property-tax was imposed on all the classes of the community, in proportion to their supposed wealth or income, hence, we may conclude, that the taxes payable in every other way, by each class, and every individual in each class, who spent his income, were probably paid, in nearly the same proportion, as the tax on property.*

It cannot, at the same time be doubted, that the agricultural classes, are much indebted to those employed in trade and manufactures, for consuming the produce of the soil. But still, it is the surplus productions of agriculture, raised under the superintendance of the owners of the soil, and by the skill and industry of those who occupy it, which constitute the real basis of our national prosperity; and exported manufactures, may be considered as nothing else, but so much beef, mutton, wheat, barley, &c. converted into another, and more convenient shape. Where manufacturers, however, are fed by the productions of foreign industry; and when the articles they manufacture, are produced from foreign raw materials, as fine wool, &c. &c. instead of being an advantage, they have the effect of depreciating the value, checking the improvement of domestic agricultural productions, and bringing foreign articles into competition with them, by means of British capital.

It likewise appears, from the following statement, that the occupiers of land, form a great, as well as valuable body; and are much superior in number, as well as financial productiveness, to the other classes in the community.

		No. of Persons.
1. Occupiers of land, with incomes under 50*l.* per annum, who were thence exempted from the tax on property, ...		114,778
2. Occupiers from 50*l.* to 150*l.* per annum, ...	432,534	
3. Occupiers above 150*l.*	42,062*	
		474,596
Total, occupiers of land, independent of artificers, and others connected with agriculture, ...		589,374

When it is considered, how usefully this numerous class of respectable and industrious individuals are employed;—that by the last enumeration of the population of England, Wales, and Scotland, the number of families connected with agriculture, including artificers, amounts to 895,998†;—that owing to the number of servants employed by farmers, each family cannot be estimated at less than six, or about 5,400,000 souls in all;—and that besides the numbers who are *directly* dependent upon agriculture for their subsistence, there are several millions *indirectly* connected with it;—we must be sensible, that too little encouragement has been given to agricultural exertions, and that the attention of the public at large, has hitherto been too seldom directed, to the improvement of the soil, or to the interests of those who occupy it.

The number of persons employed in trade and professions, assessed to the property-tax, stood thus:

		No. of Persons.
1. Persons in trade and professions under 50*l.* per annum, and thence exempt from the tax,		100,760
2. Above 50*l.* and under 150*l.*	117,306	
3. From 150*l.* to 1000*l.*	31,928	
4. From 1000*l.* and upwards, ...	3,692	
		152,926
Total, ...		253,686

* It is this respectable class of occupiers, who are most to be depended upon, for the improvement of a country. Small farms, at a low rent, may do without science, but great farms, with a high rent, cannot be carried on successfully, without the advantages of theoretical knowledge, united to practice.

† The 589,374 are those *who occupy land;* the 895,998 families, include married servants, and labourers employed in husbandry; also agricultural mechanics, as plough-makers, &c.

Consequently, there were 474,596 *actual contributors* to the property-tax, among the agricultural classes, and only 152,926 in trades, and all other professions, making the number of actual contributors connected with agriculture, more than all the other classes put together, 321,670.

These statements, must satisfy every impartial individual, that the strength and resources of this country, principally arise from the productions of the soil;—*that the land, is the basis of our national wealth**, and that on the amount, and the value of its productions, our commerce and manufactures, and the payment of the public creditors, in a great measure depend. The revenues of the church;—by far the largest proportion of the payments to the poor;—and various other public charges, are likewise payable from the same source. Hence, nothing can be more impolitic, than to neglect the adoption of any measure, by which the interests of agriculture may be promoted; or more hazardous, than to take any step, by which its prosperity can be impaired, or those who live by it, reduced to poverty or ruin.

The means for promoting the agricultural prosperity of the country, therefore, merit our peculiar attention†.

It has long been considered as an incontrovertible proposition, and approaching to the nature of an axiom, "That whoever could make two ears of corn, or two blades of grass, to grow upon a spot, where only one had grown before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

This, however, cannot be admitted, for there are no means, by which such immense benefits can be conferred upon agriculture, as by a judicious system of civil polity. In fact, the prosperity of agriculture, *depends upon the poli-*

* It is hardly to be credited, how little the superior importance of agriculture, was known to the ministers and statesmen of this country, before a Board of Agriculture was established. Proofs of a circumstance of so extraordinary a nature, will be found in the Appendix.

† Mr. Curwen justly observes, that our internal or domestic resources have been greatly undervalued and neglected, while the benefits of foreign commerce have been nationally over-rated, and assiduously protected. This in a great measure may be referred, to a want of knowledge of their substantial interests, on the part of the landed representatives, when opposed, in the legislative assembly, to the finished competence, and sagacious adroitness, of commercial members, whenever or wherever their immediate or remote interests are likely to become affected. There is no species of property in this country, the intrinsic or relative value of which, is so little the study of those to whom it belongs, or the apparent or latent interests of which, are so little understood, or so much neglected, as the surface territory of Great Britain.—*Curwen's Report*, p. 8.

tician. The better and the more equitable the civil polity of a country, the more perfect will its agriculture become. Those politicians or statesmen, therefore, who, by removing every obstacle, and furnishing every proper encouragement to agriculture, promote its advancement, have a higher claim to the gratitude of mankind, than those who have merely performed a secondary or practical part, which part, they never could have performed at all, but under the protection of wise laws, regularly administered, and executed with impartiality and vigour.

This leads to the most important discussion, perhaps, in the whole range of political inquiry, and respecting which the most ill-founded prejudices are unfortunately entertained, namely, "What public attention and encouragement, for the advancement of Agriculture, ought a wise government to bestow?"

Many able men, *reasoning solely from the abuses to which the system of encouragement is liable,* have thence been induced to condemn this policy, and to recommend that of giving to individuals, the entire freedom of exercising their industry, in their own way, without any legislative interference whatever. They dwell much, on the reply once made by some of the principal merchants of France, to the celebrated Colbert, who having asked, *What government could do for them?* was answered, "Laissez nous faire," *(Let us alone).* On the other hand, they totally reprobate *the mercantile system,* as they call it, (or a series of laws which have been enacted in this country, for promoting the prosperity of commerce), as in the highest degree impolitic; though, under that very system, the commerce of Great Britain has risen to a height, altogether unexampled in history. But as our legislature have wisely deemed it expedient, to protect both manufactures and commerce, which, under such a system, have so eminently flourished, no good reason can be assigned, why agriculture ought not, in the like manner, to be encouraged in Great Britain, where it produces such a great revenue;—where, with almost a thousand millions of national debt, we still have above twenty millions of acres, lying in a state comparatively waste and unproductive;—where the population is rapidly increasing;—and where it has been found necessary, for some years past, to import no inconsiderable portion of the means of our subsistence*.

* But if this is bad policy, as it relates to Great Britain, is it not still

It is certainly better to let agriculture alone, than to establish injudicious regulations respecting it. But if a government will make such inquiries, as may enable it to judge of what can be done with safety and advantage; and will promote agricultural industry, not only by removing every obstacle to improvement, *but by granting positive encouragement;* agriculture will prosper with a rapidity, and will be carried on to an extent, which is hardly to be credited; and in a much superior degree, than by the "let alone system," under the torpor of which, ages might pass away, without accomplishing, what might be effected in the course of a few years, under a judicious system of encouraging regulations.

The principal encouragements, which a wise and liberal government will be anxious to bestow upon agriculture, may be classed under the following heads: 1. Removing obstacles to improvement; 2. Relieving agriculture from any burdens peculiarly affecting it; 3. Promoting the collection and diffusion of useful information; 4. Giving a preference to domestic productions in the home market; 5. Encouraging the exportation of any surplus produce that may remain on hand, after the demands at home are supplied; 6. Extending, by every prudent means, the cultivation of waste lands, in order that the productive territory of the country may be constantly on the increase; 7. Granting public aid to substantial improvements, such as roads, bridges, canals, &c. on which the agricultural and general prosperity of a country so essentially depend; and, 8. Countenancing the establishment of corporations, to furnish the means of carrying on such improvements, as are beyond the power of individual wealth or enterprise.

worse *with respect to Ireland*, where agriculture is the chief source of wealth, and revenue; and where its population is principally supported by the cultivation and produce of the soil. During the late wars, Ireland was a flourishing country; her farmers had encouragement to improve and cultivate, and were well paid for their exertions; and the landed proprietors, had the means of contributing largely to the wants of the state, from the ample revenues which they enjoyed. But in the present state of agricultural depression, many branches of the community are either bankrupt, or reduced to distress; and it does not appear, that any part of it has been benefited.—*Remarks by Edward Burroughs, Esq.*

Sect. I.—*On removing Obstacles to Improvement.*

There is no duty, more incumbent on the government of a country, or from which more advantage might be derived, than that of ascertaining, those obstacles to improvement, which are occasioned by the defectiveness of the laws. In England, property held in common, cannot be divided, without the unanimous consent of those having an interest in it; and even the crown, corporate bodies, and the guardians of minors, cannot consent, unless authorized by a special act of the legislature. Nothing can be more impolitic, than retaining such impediments to improvement. Such legal disabilities to consent to enclosure, ought to be removed by a general law, and a division to be authorized, when agreed to by a majority in value of the parties interested, by whom commissioners for that purpose might be appointed. Various attempts have been made, to procure the sanction of Parliament to such regulations, but hitherto unsuccessfully, owing to the influence of those, who feel an interest in preserving the present system, and its abuses. It is full time to give up legislating *in detail*, and to act upon broad principles of general polity*.

Sect. II.—*On relieving Agriculture from Burdens peculiarly affecting it.*

This is a subject that has been already discussed. (See Chapter I. Sect. 9). The exaction of tithes in kind, and heavy assessments for the maintenance of the poor, are felt with peculiar severity by the farmers in England; and if continued on their present footing, must ultimately in a great measure destroy the value of landed property in that part of the kingdom, or at any rate prevent its improvement. The interests of the church cannot be affected, if a fair commutation be given for tithes, payable in corn, instead

* The only plausible objections, to a General Bill of Enclosures, that it might have the effect, of drawing off capital and industry from land, which, in the end, would yield the best returns, instead of being wasted, in hazardous speculations, on barren soils. But on various accounts, this need not be apprehended. The lands of moderate fertility, would be laid down in grass, in which state, they would accumulate strength; and, the poor soils, in the interim, would, under proper treatment, be yielding crops, considerable in respect of produce.

of persevering in a system, accompanied with so much private vexation and public injury. In regard to the poor-rates, it is on all hands allowed, that some plan must be devised, to alleviate that heavy and still increasing load, which, in many cases, has already become more oppressive, than all the other burdens upon land, united.

Sect. III.—*On promoting the Collection and Diffusion of Useful Knowledge.*

It is a saying sanctioned by the authority of Bacon, that "*knowledge is power.*" Of all the various sorts of power, enumerated by that great philosopher, this seems by far the most important. What gives one man any real superiority over another, but the knowledge he possesses? What enables some individuals, to produce abundant harvests,—to carry on a prosperous commerce,—to establish successful manufactures,—to excel in mechanism, or any other useful art; but the acquisition, and judicious application of that knowledge, in which others are deficient?

That the power and prosperity of a country depend on the diffusion of useful knowledge, can hardly be questioned; and there is, probably, no art, in which a variety of knowledge, is of more essential importance, than in that of agriculture. The extent of information necessary to bring it to any thing like perfection, is far greater than is generally supposed. To preserve the fertility of the soil;—to free it from superfluous moisture;—to cultivate it to the greatest advantage;—to raise its productions at the least expence;—to procure the best instruments of husbandry;—to select the stock likely to be the most profitable;—to feed them in the most judicious manner, and to bring them to the most advantageous markets;—to chuse the plants best adapted for the soil and climate, and the most likely to become profitable;—to secure the harvest, even in the most unpropitious seasons;—to separate the grain from the straw with economy and success;—and to perform all the other operations of agriculture, in a judicious manner, require an extent, and variety of knowledge, greater than may, at first view, be judged requisite*.

* Dr. Coventry observes, that the accumulated experience of ages are requisite, to perfect one's kuowledge in several departments of husbandry. The difficult and extensive nature of the subject, the importance and the im-

But though agricultural knowledge may be diffused over a country, experience teaches, that it cannot be usefully improved, unless by comparing the various practices which subsist in different parts of it. One district has been led to pay a peculiar and successful attention to one branch of husbandry, or, by a fortunate accident, some important discovery has been made in it, while other districts excel in other particulars of equal importance. Mutual benefit is derived from the communication of such local practices. Of this, the improved modes of draining by Elkington;—the warping of land on the banks of the Humber;—the drilling of turnips and potatoes in the northern part of the island;—and the more general use of the threshing-mill, and various other articles of agricultural machinery, may be cited as examples.

The advantages that may be derived, from the result of inquiries carried on by the Board of Agriculture, in so far as regards the culture of arable land, may thus be briefly stated: The means have been explained, by which, in fertile districts, and in propitious seasons, the farmer may, on an average, confidently expect to reap, from 32 to 40 bushels of wheat; from 42 to 50 bushels of barley; from 52 to 64 bushels of oats; and from 28 to 32 bushels of beans, Winchester measure, per statute acre. As to green crops, 30 tons of turnips, three tons of clover-hay, and from eight to ten tons of potatoes, per statute acre, may be confidently relied on. In favourable seasons, the crops may be still more abundant; but even these average ones, spread over a large proportion of the United Kingdom, are sufficient to produce more solid wealth, than can be furnished by the greatest extent of foreign commerce*.

The various means, by which useful information may be collected and diffused, are, 1. Forming institutions for that purpose;—2. Establishing experimental farms;—3. Insti-

mense variety of the particulars relating to it, the vague, the doubtful, and even the contradictory details of alledged facts in almost every branch of it; the obscurity of the principles on which are grounded several operations in agriculture, and other parts of rural business, and of those which influence, explain, and tend to regulate, in certain cases, the general practice of husbandry, augment the difficulties attending the acquisition of agricultural knowledge.—*Dr. Coventry's Discourses*, p. 9.

* The advantages of *an improved system of husbandry*, can hardly be too highly estimated. Where it is established, there is ample employment for the industrious labourer; whereas, where the old system prevails, there is but little demand for labour. See this exemplified in Dr. Rigby's Report, p. 96.

tuting agricultural professorships;—and, 4. Improving veterinary knowledge.

1. *Institutions for collecting and diffusing Agricultural Information.*—The establishment of a Board of Agriculture in Great Britain, scanty and limited as its means have always been, has produced the happiest effects* ; and will probably in future be considered, as an era in the history of the art. Notwithstanding the limited powers of that institution, the most distant parts of the country were soon made acquainted with each other's useful practices; and the knowledge of beneficial inventions, which, from the insulated state of farmers, might for centuries have been confined to the place of their origin, were at once rendered generally accessible. The publication of the County Reports in particular, has proved of peculiar importance, from the discussions which they occasioned;—the spirit of emulation which they excited;—the knowledge which they were the means of circulating;—the truths which they established;—and the errors which they contributed to overturn†. Animated by the example of that Board, a much greater number of agricultural societies were soon constituted, than had ever before existed in this, or any other country; there being hardly an extensive district in the United Kingdom, in which one, and sometimes more of such associations, were not established‡. A zeal for the improvement of husbandry, was thus cherished and kept up; and in the course of friendly and familiar con-

* In the Appendix will be found, an interesting account of the Bills of Enclosure, past in the course of 40 years, preceding 1814, in two periods of 20 years each. During the space of the first 20 years, which was prior to the establishment of a Board of Agriculture, the number of these bills, amounted only to 749, or 37 on average. During the second period, of 20 years, posterior to the establishment of the Board, the number had increased to 1883, and the average to 94. The difference in favour of the latter period, consequently was 1134, and the average increase was 57. The difficulty often experienced in the importation of foreign corn, and the high price which it reached, joined to an increased circulation, must have contributed to these improvements, but the basis was laid, by exciting a general spirit of improvement, and establishing a Public Board, for the protection of Agriculture.

† In these late reports and publications, which excel very differently, there is detailed, more useful and distinct information, on various branches of agriculture, and on rural concerns in general, than was in print before these were drawn up.—*Coventry's Discourses*, p. 187.

‡ There is a list of those in England and Wales, in the Derbyshire Report, vol. iii. p. 651; and of those in North Britain, in the General Report of Scotland, vol. iii. p. 417. The meetings of such societies are of great use, by the information which they are the means of circulating, and the improvement which men derive from a combination of thought, and an inducement to compare and to examine.

versation, useful observations were made, new facts were brought to light, and practical knowledge, derived from experience, generally diffused. Much good has already been done by these societies; but still more would have been effected, had the Board of Agriculture been placed on such a footing, that it might have acted as a common centre, to all these numerous associations, and for that purpose, had been invested with the privilege of correspondence postage free. The Board would thus have been enabled, better than at present, to perform those public services, which were in the contemplation of those, by whose exertions it was originally established*.

2. *Experimental Farms.*—The art of agriculture can never be brought to its highest degree of perfection, or established on rational and unerring principles, unless by means of experiments, accurately tried, properly persevered in, and carefully registered. The ardent inquirer has been too long compelled to rely on vague opinions, and assertions which have not been warranted by sufficient authority; it is full time, therefore, by the establishment of experimental farms, under the sanction, and at the expence of government, or by enabling the Board of Agriculture, to grant adequate premiums to deserving persons, for new discoveries, to bring the art to as great perfection as possible, by ascertaining the principles on which it can most profitably be conducted.

It is said, that there are many distinguished characters, who carry on experiments for their own information and amusement, by means of which, every important fact, will in process of time be ascertained†; and it cannot be doubted, that their example is of very great advantage to those, who have the means of examining the progress that is made.

* On the Continent, particularly in France, correspondence respecting agriculture, literature, and other useful objects, is carried on through the medium of the Minister for Foreign Affairs.

† The little prospect there is of having accurate experiments made, on farms of that description, is very ably explained in a communication from Mr. Blaikie, the manager of Mr. Coke's great farm at Holkham, of which the following is an extract: "These experiments are satisfactory, *so far as they go;*—but certainly not conclusive, because the produce was in no one instance, either weighed or measured.—This I much regret. But it appears to be almost impossible to conduct such experiments, with a requisite degree of accuracy, upon a farm establishment of such magnitude as that of Mr. Coke at this place. For during the hurry and bustle incident to collecting the harvest;—the farm manager has so many important concerns to attend to, that he cannot devote any portion of his time to superintending experimental objects, and were he to depute the management of such concerns to the labourers, it is not to be expected, that they would pay the attention requisite."

Their farms, however, are, more properly speaking, *pattern farms*, for the advantage *of the farmers in their immediate neighbourhood*, than experimental ones, in the strict sense of the word; and they are too often, rather the partial records of successful experiments, than the faithful journals of success and of disappointment. In order to render experimental farms generally useful, they ought to be open to the inspection of the public; the account of each experiment ought to be regularly published, and every new practice, likely to improve the cultivation of any considerable part of the kingdom, ought to be examined with the utmost precision, every trial repeated for confirmation, and, if possible, made by different persons, in different places, and on different soils.

It cannot be expected, that persons of high rank, whose attention is necessarily directed to other objects, should renounce their ordinary pursuits, and devote themselves exclusively to the conducting of agricultural experiments: but if one or more experimental farms were established, under a proper system, it would ere long be discovered, what practices ought to be avoided, as well as what ought to be pursued. It is important, that the one should be made known as well as the other; yet *errors in husbandry*, are seldom communicated to the public, or known beyond the sphere of a confined neighbourhood, because a farmer is in general ashamed of acknowledging his want of success. Unfortunately also, when his experiments answer, they are sometimes concealed, least others should avail themselves of the discovery. The object of an experimental farm, however, should be, to ascertain facts, *and to publish them;* and as much credit would be acquired, by an intelligent conductor of an experimental farm, for his exertions in detecting errors, as in establishing facts likely to be useful*.

It would surely be a highly beneficial measure, for a country, possessing such an immense revenue, to lay out any moderate sum that may be necessary, were it only 5000*l.* per annum, for ten or twenty years, to ascertain points of such essential importance, and which might be the means of making very great additions to the national produce, wealth, and revenue.

3. *Agricultural Professorships.*—It is not many years ago, since, at the expence of a private individual (the late Sir

* There is an ingenious Essay on this subject, by Dr. W. Richardson, in the Philosophical Magazine, vol. xlviii. p. 262.

William Pulteney), a professorship was established at Edinburgh, for reading lectures on the art of agriculture. The utility of such an institution is so evident, that it ought to be extended to all the other universities. The attention of young men, by such establishments, would be directed early to this most useful of all the branches of knowledge, which has now become the general subject of conversation, wherever they go. If they inherit landed property, agriculture is the topic to which their views should be particularly directed; and as there is scarcely any profession, which will preclude them from spending some part of their time in the country; and if, after having accumulated a fortune, they become proprietors of land, their having early acquired such knowledge, would be a source of much gratification, and perhaps of advantage. For such establishments, no new grant would be necessary, or required from Parliament, but merely an act, suppressing those professorships, which are at present sinecures, or of little real utility, and establishing in their room, those of agriculture*.

4. *Improvement of Veterinary Knowledge.*—Some encouragement has been given, by an annual grant, to the acquisition and diffusion of veterinary knowledge; a deficiency in which, had proved so fatal to the public interest. It is not improbable, that for every pound of public money that has been in this way laid out, a thousand has been saved in our national expenditure, in the article of horses alone, employed in the cavalry and artillery. It would be desirable, indeed, that schools for veterinary knowledge, should be established in all the principal towns in the kingdom; and that the preservation of every species of our valuable stock of domestic animals, should no longer be left to ignorance or quackery, but that the practice to be adopted in the management of their disorders, should be grounded on scientific principles.

* Public lectures on agriculture, if discreetly composed, and intelligibly delivered, doubtly possess, among others, the following advantages:—They are calculated to abridge the labours of the attentive inquirer, and to direct the general course of his researches, so that it shall be more easy, and more successful than otherwise; to solicit his attention, not only to what is confessedly of importance, and generally studied, but likewise to many new discoveries and improvements as they rise; and to other particulars, which, though they may have hitherto obtained little, if any regard, are nevertheless of material consequence, to enliven the mind, and afford some relief from the tedious irksomeness of solitary study, and to fix more strongly in his memory, both the principles of agriculture, or rather husbandry, as a science, and its rules as a practical profession.—*Coventry's Discourses*, p. 3.

Sect. V.—*To give a Preference to Domestic Agricultural Productions in the Home Market.*

This is peculiarly necessary, both to preserve the country from famine, and to render it independent of other nations for the necessaries of life. To permit the industry of any foreign nation, to enter into competition with our own domestic industry, or productions, is not allowed in the manufactures of linen or cotton, and many other articles, and ought still less to be suffered in that of corn.

If two nations, similarly circumstanced in regard to soil, climate, labour, and circulation, were to give each other reciprocal liberty of trading, the system, on the whole, might not be materially injurious to either; but to place in competition the industry of one country, which has a great national debt, and heavy taxes, and where the price of labour must consequently be high, with that of an indefinite number of other countries, which, with better climates and more fertile soils, are not subject to the same burdens, would be highly inexpedient. Besides, no country that has sufficient extent of surface, and can by any exertion produce food for itself, would act wisely, to allow itself to be dependent on others for subsistence.

The equitable principle, therefore, is, to impose a protecting duty on all foreign agricultural productions, until their price be at least as high as that at which they can be raised in Britain, in seasons of moderate fertility, and gradually to diminish that duty as prices rise, but still, giving a decided preference, to the produce of the agriculture of the United Kingdoms.

The exportation and importation of grain, and other agricultural productions, either duty free, or at low rates, in justness and equity, can only take place between nations, where the value of money is the same, where they are subject to the same weight of taxation, are similarly situated in regard to soil and climate, and live in amity with each other*.

* It may certainly appear at first sight extremely hard, that a large proportion of the community should be obliged to pay a price for the first necessary of life, so much above that at which it can be imported from other countries. But we must take into consideration the ruinous consequences which would result from a free trade in grain; for when individuals are left at liberty to pursue a gainful commerce, the general interest of the community operates little on their proceedings. Thousands would be deprived of

Sect. VI.—*To Encourage the Exportation of any Surplus Produce.*

It is likewise highly expedient, to promote the exportation of domestic produce, if there be any redundancy, after supplying the demand at home. It is not sufficient to permit the exportation; but it may be necessary, for the encouragement of domestic cultivation, and in order that the articles grown at home, may be enabled to meet the productions of other countries, in foreign markets, *on equal terms*, to give what is called a bounty on exportation. Nothing, however, can be more erroneous, than to consider that encouragement *a bounty*, when it is in fact *a drawback*, under another name. The farmers at home, are subjected to a variety of taxes, which are not imposed on their foreign competitors. To enable them to meet on equal terms, they are entitled to receive an allowance, on every quarter of grain exported, equal to what they had actually paid on its account to the public, under various denominations. It is but just, that the government should repay the taxes it had received, on what is thus exported, to enable the farmers, under its protection, to enter into a fair competition with foreign cultivation; more especially if the rates at which importation is allowed, are so fixed for the benefit of the manufacturers, that the corn growers can, at no period, obtain great profits, the increased price being, in general, only a bare compensation for deficiency of produce.

Sect. VII.—*To promote the Improvement of Waste or Unproductive Lands.*

It is of peculiar importance to a country, increasing in population, to be constantly adding to its productive territory. There are different ways by which that object may be promoted: 1. By facilitating the division, drainage, embankment, and improvement of commons, meadows, or

work, the distresses of our population would be fearfully augmented, and whilst bread might be cheaper, the many, from want of labour and adequate wages, would have it less in their power to become purchasers. To shut out foreign grain, may be an evil, I mean not to question; yet much as I deplore the necessity for importation, I verily believe, that it is against the general interests of the working classes, to suffer foreign corn to come into the country, below the average price at which it can be raised in Britain.—*Curwen's Report*, p. 7.

other intermixed lands; at least in all cases where two-thirds, or three-fourths of the parties concerned, are in favour of any such measure; and this benefit might be made attainable, by an act of the legislature, authorizing an application to the Quarter Sessions in England, or Sheriffs in Scotland, to order an inspection, and a report of the expence, &c. to be made, and after hearing parties, to decide on the propriety of the application. If then approved of, the direction and execution of the improvement, should be referred to commissioners;—2. By exempting from the payment of tithes and poor-rates, for a term of years, according to the expence of the improvement, waste lands brought into cultivation;—and, 3. By fixing the price at which foreign corn should be permitted to be imported, free of duty, at such a sum, as will enable a British farmer, to defray the expence of reclaiming waste, or improving uncultivated land. For unless this be done, it is impossible, that the produce of our *barren soils*, cultivated at a great expence, can stand a competition, with the produce of the *fertile fields* of other countries, where the expence of cultivation must, comparatively speaking, be inconsiderable.

Among our *unproductive lands*, a large proportion of those subject to the process *of fallow*, ought to be included. In Scotland, owing to the stubbornness of its clayey soils, and the wetness of its climate, any material diminution cannot at present take place; nor until the soil is rendered much more friable, which it will probably be, in the course of such improved cultivation as these lands now experience. But there are extensive tracts in England, where, instead of a naked fallow, turnips, and other green crops, might now be cultivated with advantage; and by means of which, food might be raised, more than we are now under the necessity of importing from other countries.

Sect. VIII.—*To encourage Permanent and Substantial Improvements.*

The wealth and agricultural prosperity of a country, materially depend, on such great and substantial improvements being promoted, as, 1. Roads and bridges;—2. Canals;—3. Railways;—4. Harbours;—and, 5. Embankments; and, where the aid of government cannot be given to such undertakings, the establishment of corporations, under the

sanction of public authority, might be found an advantageous mode of carrying such improvements into effect.

1. *Roads and Bridges.*—As the first means of introducing improvements into a country, roads, and bridges are essential; and where the population is thin, and the country is poor, there is no possibility of having such communications made, without public assistance. Two plans for that purpose have been adopted in making roads. By the one, the military have been employed in such public works; by the other, under the authority of Commissioners appointed for that special purpose, the public has agreed, in the more remote parts of the country, to advance one-half of the expence of making roads and bridges, where the proprietors come forward with the other. The communications which have been opened, in consequence of this encouragement, are numerous, and the public will soon be amply indemnified, for any sum it has thus expended, by the increased revenue it will derive from districts, which have hitherto been unproductive*.

In times of peace also, the military cannot be better employed, than in carrying on public works of so useful a description, as roads, canals, &c. Unless when engaged in war, soldiers are the better for being thus actively employed: it strengthens their bodies, and occupies their minds. The remains of those roads, which were constructed by the Roman armies, fully prove, what that intelligent nation considered to be the best means of preparing soldiers, in time of peace, for the hardships, and achievements of war.

2. *Canals.*—The advantages of canals to agriculture, need not be dwelt upon. They facilitate the means of conveying the bulky productions of the soil to market, and also of bringing, at a moderate expence, not only coal, but lime, and other manures, to the farmer. Under a proper system

* In the 8th Report of the Commissioners for Highland Roads and Bridges, ordered to be printed in March 1817, there is an abstract of the proceedings of these Commissioners, since the year 1803, a period of about 14 years. During all that time, they have only expended about 200,000*l. of public money*, the rest arising from private contributions, with which they have made, about 950 miles of road, and 1100 bridges. That includes 42,175*l.* for surveys, and expence of management. This is only at the rate of about 14,285*l.* per annum. How any one can question the policy of continuing so trifling an expenditure, while required in any part of the United Kingdom, can hardly be credited. Frederick the Great, from the moderate income which Prussia afforded in his time, laid out no less a sum than 300,000*l.* per annum, in promoting such public improvements. What then ought not to be done with such a revenue as Great Britain furnishes?

also, the surplus water might be usefully employed, for the purposes of irrigation. On all these accounts, canals ought to be encouraged by the government of the country. It is not desirable, except in very particular cases, that they should be executed at the public expence; but it would greatly promote such useful undertakings, if government were to lend a certain sum to the proprietors of such canals, at a moderate interest, to enable them to complete any undertaking of that sort. This was done for the Forth and Clyde navigation; and the Company has since repaid the loan. The same plan might be successfully adopted in other instances; and the principle is at last sanctioned by parliament, in a recent act, the effects of which, under judicious management, can hardly fail to prove highly beneficial*.

3. *Railways.*—This new mode of conveyance, is capable of being rendered as extensively useful as canals, and is well entitled to the encouragement of government, by loans of money, at a moderate interest, to carry them on. The government of this country, can always borrow money at a cheaper rate than private individuals, from *the speculation* that attends public loans; and the easiness with which the monied interest can re-invest their savings in the funds, in preference to any other security. Railways would be particularly convenient, where canals are impracticable, and where either may be undertaken, the former, affording communications at all seasons, will often be preferred. They ought to be promoted, because the more that communications can be opened between one part of the kingdom and another, the more does a country prosper, and the more are the people in it combined into one great community.

The extension of railways and canals, is to be considered in another point of view, namely, as diminishing the number of horses, the maintenance of which, is the great cause why our agricultural productions, are not adequate to the subsistence of our inhabitants. Let the unemployed poor, therefore, be employed in the construction of these useful public works, and we should soon be able, to feed ourselves,

* These suggestions have been fortunately adopted, an Act having been passed, in June 1817, "To authorize the issue of Exchequer bills, and the advance of money, to a limited amount (1,500,000*l.*), for carrying on Public Works and Fisheries, in the United Kingdom," &c. which, there is no doubt, under proper management, will be attended with the most advantageous consequences.

by the advantages resulting, through the medium of their labour; and the appropriation of land, now devoted to the production of food for horses, to that of food for man.

4. *Harbours.*—Though harbours are more essential in a commercial, than in an agricultural point of view, yet they are still of material consequence to the husbandry of a country, by facilitating the exportation of bulky articles of produce, and the importation of coal and lime, those essential articles to the farmer. The same plan of public assistance, either in whole, or in part, will be found as useful in regard to harbours, as to railways or canals, and has answered in practice. Certain sums of money, (arising from the forfeited estates in Scotland), which were at the disposal of Parliament, were granted for improving harbours on the north-eastern coast of Scotland. The sums given were trifling; in general from two to four thousand pounds each; and excepting in one instance, where the sum was granted to encourage a fishing establishment, erected by a public spirited company (the Society for improving the Sea-coasts of the Kingdom), the inhabitants of the towns or neighbourhood, where that assistance was bestowed, were bound to furnish one-half of the total sum to be expended. The effect of this system has been most beneficial*. It is not so much indeed the sum actually given, *as the spirit which it excites*, that is of service; and when once such a spirit is roused, it is not confined to one object, but extends itself to others. Little causes thus produce great effects; and a moderate public expenditure of a few thousand pounds, may lay the foundation of an extensive fishery, or a great emporium of commerce, and promote, at the same time, the agricultural prosperity of an extensive district.

5. *Embankments.*—When the difficulty and hazard of embanking a considerable tract of country, either against the overflowings of a lake or river, or the inroads of the sea, are considered, there is no undertaking, that seems better entitled to the encouragement of a wise government. Extensive tracts of fertile territory, may thus be acquired, greatly to the public advantage. The soil thus obtained, is generally of a nature peculiarly productive, and well adapted

* The Harbour Commissioners have received in all, from the balances arising from the forfeited estates in Scotland, 25,133*l.* With only 20,010*l.* of that sum, they have already, either made or improved ten harbours, and a canal, the remaining expence being paid by subscription. Is it possible to lay out public money more advantageously? and why should not so useful an expenditure be continued?

for agricultural purposes. To carry on such undertakings, however, at the public expence, might be hazardous; but when their utility, and ultimate profit, are sufficiently proved, by the evidence of intelligent engineers, to the conviction of Parliament, it may be advisable for the legislature, in times of peace, to authorize the advancing one-third, or any other proportion of the estimated expence, at a moderate interest.

Where extensive drainages are necessary, the same encouragement ought to be given.

6. *To establish Corporations for carrying on Beneficial Improvements.*—Many of these improvements might be successfully promoted, *by the establishment of corporations*, for carrying on particular objects, which cannot be effected by individual wealth*. This is frequently done in the case of canals, and ought to be extended to other useful objects. The formation of such associations, is at present the more expedient, that there is likely to be a large capital, requiring profitable employment, much of which will be sent abroad, unless it can be laid out at home with advantage. Much good therefore might be effected, by erecting public companies, for specific objects of improvement;—for employing the poor in agriculture;—or for lending money to all such landed proprietors, as had any great improvement to execute; the sum advanced, never to be demandable, but the stock of the company to be transferable, like other public securities, which would answer equally well the purposes of those stockholders, who might wish to receive again the sums they had subscribed. Estates under the fetters of strict entail, might thus be improved, which otherwise would be neglected. The surplus capital of the country would thus be employed at home, *and embodied*, it may be said, with our own territory; and the whole country would be improved in a manner, and to an extent, that cannot otherwise be attainable.

It was by promoting such measures as these, that the most celebrated statesman of modern times, justly called Frederick the Great (more from his attention to internal improvement, than to foreign conquests), raised his dominions, notwithstanding the disadvantages of situation, soil,

* The Bedford Level Corporation, is an example of that sort in England.

and climate, to that height of prosperity and power, to which they attained during his reign*. His practice was, to lay out about 300,000*l.* sterling *per annum*, in the encouragement of agricultural improvements, which he considered, "as manure spread upon the ground," to secure an abundant harvest; and in fact, instead of being impoverished by such liberal grants, he thereby increased his revenues so much, that he was enabled to leave a treasure behind him, amounting to above 12,000,000*l.* sterling†. On the other hand, this country, owing partly to unfavourable seasons, partly to its increased population, and in no small degree, to its agricultural interest not being sufficiently encouraged‡, has been under the fatal necessity, of transmitting to other nations, above 57 millions sterling, in the space of twenty years, and no less a sum than 12 millions, *in one year*, to procure food for its inhabitants!

The celebrated Watson, Bishop of Llandaff, has most ably explained, the advantages to be derived by agriculture, from such public encouragement, in the following words: "The agricultural improvements which have hitherto taken place amongst us, have been, by the expenditure of private wealth; but the country cannot be brought *to that perfection of cultivation*, of which it is capable, unless individual efforts, are aided and accelerated, *by public wisdom and munificence*. I boast not of any particular patriotism, but I would willingly pay my share of twenty or thirty millions of public money, to be appropriated by the legislature, to the agricultural improvement of Great Britain and Ireland. This appears to me, to be an object, of far nearer concern to our independence as a nation§, than any extension of com-

* Cromwell followed the same system. To promote Agricultural improvement, he gave 100*l.* per annum, (a large sum in those days), to a farmer of the name of Howe, in Hertfordshire, to encourage him to introduce turnips and clover into that county.—*Herts Report*, p. 55.

† In the works of the celebrated Count de Hertzberg, a particular detail is given of the measures taken by Frederick the Great, for promoting the agricultural prosperity of his dominions, and the particulars of all the immense sums bestowed by him for that purpose. They are detailed, in "Miscellaneous Essays," by Sir John Sinclair, printed an. 1802, p. 260.

‡ Had agriculture been sufficiently encouraged, such a breadth of land, would have been brought into cultivation, as would have rendered importation unnecessary; and our own farmers, would have derived the whole benefit of those high prices, which the deficiency of their crops required.

§ Any government, whatever its form may be, must always be in a precarious state, when its agriculture ceases to furnish the means of subsisting its inhabitants; and it is acknowledged, that the fear of famine, has as often dictated to potentates, the necessity for making peace, as either conquests or defeats.—*Curwen's Report*, p. 4.

merce, or any acquisition of distant territory ever can be. If the time had fully come, when an unproductive acre of land could not be found in either of these, our *fortunate islands*, we shall then have food within ourselves, for the annual sustenance, of at least thirty millions of people, and with a population of thirty millions, what power in Europe, or what combination of powers, will dare to attempt our subjugation*."

May these considerations be listened to by those, who take an active part, in conducting the government of this great empire; and may some effectual steps be taken, by encouraging cultivation and improvement, in the manner above suggested, or by such other means as may be judged most useful, not only to prevent, what is justly accounted the greatest of all possible calamities, scarcity or famine, but also to promote, the future permanent welfare and happiness of the people.

JOHN SINCLAIR.

Ormly Lodge, Ham Common,
Surrey, 20th June, 1817.

* Communications to the Board of Agriculture, (Essay on Waste Lands, by the Bishop of Llandaff), vol. vi. p. 12.

APPENDIX.

No. I.—*Of Leases.*

The general nature of the connexion between a proprietor and his tenant, has been already explained (See Chap I. Sect. 8). It is here proposed to consider, 1. The manner of settling the contract between the parties;—2. The terms of entry, and regulations connected therewith;—3. The duration of leases;—4. The covenants to be inserted in them;—and, 5. The form of the lease.

1. *Manner of settling a Lease.*—When a lease is to be granted, the first rule which claims attention is, that the new lease should, if possible, be arranged two or three years before the expiration of the old one. Indeed, whether a new farmer is to be introduced, or the old one continued, this plan is equally advisable. It is another rule, that, on equal terms, the old tenant ought to be preferred, unless his conduct is particularly faulty. His management goes on regularly, and he must be a gainer, whilst the landlord profits, by warding off any attempt at exhausting crops, during the three or four last years of the lease. If an agreement cannot be entered into with him, the proper plan for a landlord to adopt is, to have the farm valued near the end of the lease, not perhaps by an entire stranger, but by the most intelligent and experienced person in the neighbourhood; nor ought a sum beyond the one thus fixed upon, to be demanded. Let the farm be offered at that rent, for twenty, or any other number of years, first to the tenant in possession, and if he will not agree to the terms, let that offerer be preferred, *who will stipulate to make the greatest exertions for the improvement of the estate, and who will leave it in the best order at the end of his lease.* In this way, the interest of the farmer, and of the proprietor and his family, and of the public, "are all combined."

2. *Period of Entry, and Regulations connected therewith.*—These are points which require no small degree of consideration; and instead of the various, discordant, and complicated practices now in use*, which the County Reports have for the first time so

* For instance, in Gloucestershire, leases commence at Lady-day, and in that case, in the Vale, the going-off tenant holds a part of the grass-lands till old May-day, and has likewise the going-off crop of wheat, with the use of the barns till the Midsummer following. In this usage there is great inconvenience, especially when the new tenant is at variance with the old one, which is not uncommonly the case. Each has an opportunity of distressing and incommoding the other, in various ways.—*Gloucestershire Report*, p. 35.

fully disclosed, it would be advisable, that some plan were fixed upon, by which the time of entry was adapted to the different kinds of farms, whether pasturing or tillage farms, and to the situation of the district in regard to fuel*, and other circumstances.

It is for the interest of the landlord and of the public, that the term should always be made favourable to the *incoming tenant*†; otherwise he may be placed in a most disagreeable predicament for the first twelve, or even eighteen months after his entry‡; may suffer materially in his interests, and may thence become dispirited, and relax in his exertions.

The points to be considered, respecting this subject, are, when the entry should be: 1. In hill-pasture farms; 2. In low-lying grazing farms; 3. In arable farms; and, 4. Under what general regulations.

1. In *hill-pasture farms*, the incoming tenant wishes to get possession of the premises, at a time when he can purchase the sheep or cattle he requires, on the most reasonable terms, namely, immediately previous to the commencement of the grass season. Hence, in the more northern counties of England and in Scotland, about *Whitsuntide* is considered to be the most convenient term for that purpose.

2. In the southern districts of England, the usual time for changing the tenant of a grazing farm, is on the 29th day of September, at the close of the previous summer, or at the season when most of the great stock fairs are holden; and it is a time which is greatly to be preferred for that purpose. It is just before the commencement of the rainy season, and the only time which can prevent an outgoing tenant doing considerable mischief to the land, by the poaching of cattle. It is likewise the most convenient season for the new tenant, not only to buy live stock, but to do various works,

* Where the fuel is peat, the entry is at Whitsunday, that the tenant may provide himself with that essential article during the summer, the only proper season for that purpose. *Forfarshire Report* p. 251.—It has been suggested, that the entry might be made at Michaelmas, or Martinmas, even where the fuel is peat, if it were incumbent on the old tenant to provide the peat, and for the new one to pay the value of it.—*Remark by Mr. Middleton.*

† Undoubtedly this ought to be the case; but in Bedfordshire, and various other counties, neglect on the part of the landlords and their agents, and over-reaching conduct on the part of the outgoing tenants, have long ago introduced the contrary practice, in almost every instance; and tenants expecting and claiming *to quit as they entered*, there seems no other means of introducing improvements in this essential particular, but for the landlords specially to *stipulate* for a new mode of quitting, at the time of the next letting; unless, by allowing a compensation, the tenants can be brought to agree, during the present term, for a different quitting at the end of it, to the entry that commenced it. If the rule be general, the outgoing tenant, if he takes another farm, will be compensated, for the loss he may sustain in the former one.

‡ Aberdeenshire Report, p. 181.

preparatory to the following summer. Indeed a successful summer occupation cannot be expected, unless the same tenant possesses the land during the previous winter. The like reasoning proves, that Michaelmas is the most suitable season for changing the tenant of the hay-farms in Middlesex*.

3. In arable farms, *Michaelmas* in the southern districts, and *Martinmas* in the more northern, are the most beneficial, to both parties.—The outgoing tenant remains till his crop is reaped, and secured from the risk of injury; whilst the incoming tenant enters when his presence and stock are necessary, to sow his wheat and tares in the autumn, as well as to prepare the lands for the ensuing spring crops; and when he can generally purchase every article he wants, on moderate terms. Some inconvenience will arise, both to the incoming and outgoing tenant, whatever be the term of entry; but perhaps, on the whole, Michaelmas, or Martinmas, for arable farms, is as little liable to objection, as any other that can be suggested; provided the fallow, and the turnip land is worked by the outgoing tenant, for which a fair compensation ought to be made to him.

It were much to be wished, that the subject were thoroughly investigated, and that some general rules were laid down, by the most extensive proprietors in the several counties, for the commencement and termination of leases, according to the climate, mode of husbandry, and a variety of other circumstances of a local nature. If this could be effected, it would soon be considered *the custom of the country*, and as such would be enforced by law. This would ultimately prove highly advantageous both to landlords and tenants.

4. As to the general regulations connected with the change of tenants, one rule is, "That the possession of the farm should be entire, and not partial." Great losses are sustained, where a contrary system is adopted; for it leads to endless disputes between the incoming and outgoing tenant, by which the interests of both are most seriously affected. Whatever portion of the crop the new tenant may want, should be valued, and paid for, at that valuation, by the new possessor. The outgoing tenant should also be paid for ploughings substantially done, as well as for such turnips as may be growing in the land, in a clean state, at the end of the lease; and for seeds left in the ground for a crop of clover, or herbage, to be obtained in the ensuing year. But on no account ought he to be permitted, to remove any straw, hay, or manure, from the premises he has occupied, which, if a general regulation would not be attended with inconvenience to any individual continuing a farmer.

* Communication from John Middleton, Esq. The late Duke of Bedford, when letting his Bedfordshire estates, in 1795, changed the term to *New Michaelmas*, making compensations in all proper cases.

3. *Duration of Leases.*—This is a subject of great importance; for unless a tenant has the certainty of enjoying the land he occupies for a determined period, he can have no inducement to make any substantial improvement*. Tenants at will, from the very nature of their tenure, are almost precluded from the possibility of making improvements, whilst they have it in their power to ruin the land they occupy†. Such is the difference between a precarious and a certain tenure, that the same land, which, *at will*, is only worth 20*s*. per acre, is considered to be worth 40*s*. *with a lease of* 21 *years*‡. It has been justly observed, that it is of little consequence whether a farmer is possessed of a capital, if from want of security in his possession, he is afraid to lay it out; and if he has no capital, he cannot procure any assistance from others, to invest in improvements, however profitable they might prove, without this essential security§.

The periods for which leases are usually granted, are,—Short leases for three, five, or seven years;—Moderate leases for 14, 19, or 21 years;—Long leases for 25, 31, or 57 years;—Leases for one life;—Leases for three lives;—and, Leases upon the payment of a fine.

1. Short leases are better than none, provided they extend to at least the number of years included in the course of cropping that may be adopted; and they may be less exceptionable, where a farm is in good condition and well cultivated; but under such leases, agriculture can never be carried to a high degree of perfection‖. A tenant on a short lease, has no inducement to try experiments; and, consequently, agriculture, on his farm, must remain for ever stationary. A man who has a considerable capital, and wishes to employ it in extensive farming, has a right to look for the comforts and conveniences of life, for himself and family, *with some degree of certainty and independence*; and if he obtain no security for possessing them, in the line of agriculture, under adequate leases, he will most assuredly renounce so unpromising a profession, and employ himself and his capital in some other pur-

* In particular cases, tenants *at will* do place such implicit confidence in the honour of a great family, distinguished by immense wealth, and hereditary virtues (for instance on the Devonshire estate), as to lay out to the amount of some thousands of pounds on single farms. *Derbyshire Report*, vol. ii. p. 36.—But such cases are rare, and many have suffered in other districts, from misplaced confidence. See Cornwall Report, p. 22.

† Middlesex Report, p. 83.

‡ Oxfordshire Report, p. 62. In Norfolk, the difference of having a lease, is reckoned worth twenty per cent.—*Kent's Norfolk*, p. 124.

§ Derbyshire Report, vol. ii. p. 36; and vol. iii. p. 634.

‖ Marshall recommends leases for six years certain, with a condition, that if neither party gives notice to quit before the expiration of the first three years, then the term to be prolonged for nine years, and so on from six years to six years, until three years notice be given by either party. *On Landed Property*, p. 365.—This is much better than no lease, but still it does not furnish an adequate encouragement to expenditure and improvement.

suit. Leases of considerable duration, therefore, are most essential requisites, for promoting the interests of agriculture, *in all cases.*

2. Leases for about 20 years*, are greatly preferable to shorter terms, for all the parties concerned. Under the security of such a term, the tenant can afford to give more rent for his land; he can spend money on improvements, with the confidence of reaping the benefit of them; and by the consequent increase of produce, his profits will be advanced in proportion to the sum he has expended; considerations, in which the interests of the landlord, the tenant, and the public, are all involved†. In general, unless where great improvements are necessary, a lease of about 20 years, is perfectly sufficient for the security of the tenant; and it is a great advantage, both to him and to the landlord, that at the end of such a period, the state of the farm should be examined, the improvements that have been made in it ascertained, and those that may still be executed, pointed out. Granting leases, also, is greatly in favour of raising rents, and consequently of promoting industry to pay them. When there is no lease, there is little more reason for raising the rent at one period than another.

3. If a farm is almost in a state of nature, and requires enclosing, liming, draining, and other expensive improvements, a lease of 25 years may be sufficient; but if a considerable sum for erecting or repairing a house and offices, a lease of at least 30 years, may be necessary, to allow the improving farmer or his family, a fair and adequate return for his expenditrue. Perhaps there is no species of lease more advantageous to the agriculture of a country, than a long one given on a farm that requires extensive improvements. A spirited tenant, who improves such a farm, considering his risk, trouble, and expences, is well entitled to more than mere remuneration or ordinary profit. In some cases, therefore, leases, to the extent of even 50 or 60 years, have been granted, and have produced great improvements in the cultivation of barren land; they are peculiarly beneficial both to the landlord and his family, when there are periodical rises of rent every ten or twelve years‡. The security of a long lease, gives scope to a variety of permanent improvements, and the rise of rent, in moderation, is a spur to exertion§.

4. Leases for a single life, are far from being favourable to improvement, though there is something benevolent in the idea, that a farmer is not to be removed during his life. When the exact length of a lease is fixed, the tenant makes his arrangements

* The exact number of years ought in some measure to depend upon the course of crops; for the tenant ought to have the advantage of at least three complete rotations.

† Kent Report, p. 48.

‡ Aberdeenshire Report, p. 90.

§ Husbandry of Scotland, vol. ii. p. 212.—This goes upon the supposition,

accordingly, and he lays out his capital early, in the expectation of having a greater return, before the termination of the lease, than if he was more dilatory in his exertions; but when the period depends upon his own life, he is apprehensive, that if he spends a large sum of money, the benefit of it may be lost to himself and family, from the uncertainty of human existence. He lays out no part of his capital, therefore, but in the expectation of immediate returns, and as age advances, he becomes the more negligent, and less inclined to exertion*. Indeed if a lease-holder for life become at any time an invalid, there is an end of all idea of improvement. He is necessarily tempted, seeing the precariousness of his life, to extract out of the soil all he can, whilst he has it in his power.

5. Leases for three lives, unless there be a rise of rent with each life, are deservedly reprobated. The occupier, secure in his possession, grows indolent, neglects the cultivation of his farm, thereby injures the community, and impairs the interest of his successor†. It has been remarked, that neither the roads are so well managed, nor the land in such good condition, on farms leased on lives, as even where no lease whatever is granted‡. Leases on lives were formerly given, to induce tenants to take farms, when little of the spirit of agricultural improvement existed§; but they are no longer necessary on that account.

6. Leases upon fines are likewise justly objected to. The sum paid down by way of fine, drains the tenant of his capital, and prevents him from improving his farm. Such leases also, partake too much of the nature of a lottery, and the calculations are too intricate for a common farmer‖. The frequent recurrence and magnitude of the fine, and the expences attending it, are likewise extremely severe upon the tenant; and requires a greater degree of economy and foresight, than is always to be met with, particularly in youth. If the fine were diminished, and the reserved rent increased, the interests of both parties would be consulted¶. On the whole, such leases are found to be so extremely injurious, that landlords see the necessity of permitting such tenures to run out, and that mode of letting land, will soon in a great measure disappear**.

It is said, that in grazing farms, a long tenure is not so necessary, and as they require less labour and expence than arable farms, they may be occupied to advantage, even on a lease of very moderate duration. But even in such cases, it would be better to grant a term of 10, 15, or 21 years, with a rise of rent

that the national currency will progressively depreciate; which is the case in its natural state.

* Husbandry of Scotland, vol. ii. p. 216.

† South Wales Report, vol. ii. p. 172. ‡ Shropshire Report, p. 136.

§ Stirlingshire Report, p. 101; Derbyshire Report, vol. ii. p. 35.

‖ South Wales Report, vol. i. p. 171.

¶ Berkshire Report, p. 54; Oxfordshire Report, p. 40.

** Holt's Lancashire, p. 26.

at certain periods, by which the tenant would not be compelled, continually to shift from place to place, and perhaps change his stock from time to time, by which his interests would be materially affected*.

In arable farms, which are already much improved, and in a high state of cultivation, it is contended, that long leases are unnecessary, because it requires less labour and expence to crop them; and it is supposed, that in the course of ten or twelve years, the tenant may have an adequate return, and an ample profit on his capital expended. Yet as no lime, or other permanent manure, will be purchased, nor any expence laid out, during the last three years, those short leases are very exceptionable. For it is clear that such a farm, by shifting its tenant every ten or twelve years, in place of advancing in fertility, will be essentially injured. A short lease, therefore, must be an obstacle to the progressive improvement of even such a farm: and it will never yield an adequate rent, nor reach the highest state of productiveness of which it is susceptible, while it continues to be held by such a precarious tenure†.

On the whole, experience has fully demonstrated, that short leases, and those whose duration is uncertain, are injurious to improvement; and that a period of about 20 years, is a fair term, in an improved country, for all parties, securing to the proprietor the progressive improvement of his land, and a periodical addition to his income; while it rouses the energy of the industrious farmer, from the certainty of his reaping the profit of his labour, skill, and capital, in consequence of his having a certain interest in the soil he cultivates‡. The successful practice and experience of Mr. Coke of Norfolk, has put this question beyond all doubt, whose rent-roll has been increased, within the memory of man, chiefly by the system of granting judicious leases, from 5000*l.* to 40,000*l.* per annum§, taking into consideration at the same time, the rise in the value of money for the last 20 years. A prejudice against the granting of leases, therefore, if not removed by the good sense of the landlords, will injure, beyond all calculation, the agriculture of the kingdom||. The difference between a lease and no lease, and between a long and a short lease, affects almost every operation that takes place on a farm. Where a regular system of leasing does not exist, not only all improvements are neglected, but often a gradual deterioration of the land is the consequence¶.

It must not be imagined, however, that leases ought to be in-

* General Report of Scotland, vol. iii. p. 378.

† Ibid. vol. iii. p. 379.

‡ Middlesex Report, p. 79.

§ Kent's Norfolk, p. 123.—When that Report was written, an. 1796, the rent was only 20,000*l.*; it is now said to be above 40,000*l.* and is likely to increase.

|| Hertfordshire Report, p. 34.

¶ Young's Essex Report, vol. i. p. 28.

discriminately given. They certainly ought not to be granted but where a farm is of a proper size; is put into a shape fit for profitable cultivation;—and where tenants can be found, possessed of skill, spirit, and capital, to carry on its cultivation. The improvement of an estate may be retarded, instead of being promoted, if leases are given of ill-arranged occupations, and to ignorant, slothful, and needy farmers, not entitled to the confidence of their landlord. Nor ought they to be granted, without proper covenants to protect that property from waste*.

4. *Covenants.*—When a lease is granted, it is essentially necessary for the interest of the landlord, who is properly a trustee for his family and the public, that it should be under such covenants, as may prevent the property from being injured, during the term agreed upon; more especially when the lease approaches to its termination, and the tenant has no peculiar inducement to prosecute his improvements, or to preserve the fertility of the soil. The necessity of such covenants, to prevent waste, is proved by innumerable examples. The fields are otherwise cropped till they can yield no more; the farm is reduced to half its value, and can only be recovered, through the means of an enriching, but expensive system, either by the proprietor taking the farm for some years into his own hand, or letting it for less rent than what it would have produced under more careful management†. In general, however, the covenants in leases are too numerous, and too complicated. Unnecessary restrictions are a great impediment to improvements, by precluding that spirit of enterprise, and of experiment, which has proved the principal source of new discoveries, and of prosperous agriculture. At the same time, where there are no stipulations for preserving the farm in good order at the termination of the lease, more especially in regard to the quantity of grass land;—the extent and cultivation of the land in fallow;—the manure to be left for the incoming tenant;—and the state of repair in which the houses and fences ought to be given up;—the farm is left in poverty and wretchedness, as has often happened to negligent landlords‡. The over-cropping of the land, towards the expiration of a lease, is sometimes called, *getting the land in readiness for the landlord*§. It has been well observed, that if the tenant deteriorates the property entrusted to him, instead of paying a share of the produce, he deprives the landlord and his family, of part of their capital. Hence tenants, like kings, as Lord Kames remarks, ought to be fettered; but not so fettered, as to bar improvement, nor left at liberty to do mischief‖.

If men were uniformly distinguished by knowledge and integrity, covenants would not be necessary. It is impossible, how-

* Husbandry of Scotland, vol. i. p. 215.
† Middlesex Report, p. 40. ‡ Husbandry of Scotland, vol. i. p. 215.
§ Cheshire Report, p. 111. ‖ Gentleman Farmer, p. 412.

ever, for any prudent landlord, to place unbounded confidence in a person, who has an interest to do him a most essential injury; since, the more he exhausts the estate, the more he may ultimately enrich himself. Such attempts at exhaustion will be made, though they have often proved as injurious to the tenant, as to the landlord. Hence it is advisable for a landlord to insist on security for the safety, and in some cases, for the improvement of his property, though, in order to obtain that security, he must be content to accept of less rent than otherwise he might receive. Covenants are, in fact, a species of rent, and though they may, for a time, diminish the annual income, yet, if judiciously formed, and clearly expressed, they will prevent the deterioration of an estate, and in that manner add to its permanent value. The true nature of a lease, under proper covenants, is an agreement, by which the proprietor accepts of a fair rent, and even rather less than the land might pay; but which furnishes the tenant with sufficient inducement, to increase the value of the farm he occupies, and thence he will be enabled to afford even a higher rent when the lease terminates. Instead of a mercenary contract, therefore, a connexion, for the mutual advantage of both parties, may thus be formed; which, if the tenant fulfils the expectations that are entertained of his exertions, is likely to be continued. In short, that great object, both for the public, and for the proprietor and his family, "*the progressive improvement of an estate,*" ought not to be sacrificed, for the hazardous experiment of obtaining a temporary advantage, at the risk of future injury.

5. *Form of a Lease.*—Leases are too often drawn up by men ignorant of agriculture, and replete with obsolete covenants, which both shackle the tenant unnecessarily, and injure the landlord, and occasion incalculable losses to the community*.

The covenants in a lease must necessarily vary, according to circumstances. It is desirable, however, to have a form laid down, distinct and simple, instead of being both complicated and confused. For that purpose, after the necessary preamble, stating, the parties contracting,—the situation of the property leased,—the duration of the lease,—and the time of entry; it is then proper to enumerate, 1. The powers and privileges reserved to the landlord;—2. The obligations incumbent on the tenant;—and, 3. The stipulations obligatory upon both. Leases thus drawn up, would not be liable to much uncertainty or dispute; and if any should occur, it is expedient, that a mutual obligation for settling the same by arbiters, should be inserted in the lease itself. Form of leases, on these principles, if approved of by the parties, can be drawn up by any intelligent conveyancer.

* Middlesex Report, p. 84.—In the General Report of Scotland, vol. iv. p. 321, the subject of covenants is more fully discussed.

No. II.—*Of Farming Accounts.*

THE keeping of regular accounts, will be found fully as advantageous in farming, as in other business; and forms have been drawn up, for recording agricultural, with as much accuracy, as commercial transactions. Such minute attention, however, cannot be expected from the generality of farmers. It is therefore proposed to give a form of accounts, of a less complicated nature, and which any person, at all competent to business, can find no difficulty in filling up. To which will be added, forms for the management of arable, pasture, and woodland, and for keeping accounts of crops, the dairy, and the increase and decrease of stock.

1. *Weekly Journal of Transactions, from to*

		State of Weather.			
		Barom.	Thermom.	Wind.	Rain.
Monday.					
Tuesday.					
Wednesday.					
Thursday.					
Friday.					
Saturday.					
Sunday.					

2. *Weekly State of Labour, from*

Names of Men and Horses.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	No. of Days.	Rate per Day.	Total.		
									£	s.	d.
Daily Labrs.											
Farm Servants.											
Horses.											
Task Work.											
Work by Tradesmen.											

3. *Cash Account.*

Dr. *Cash received.*						Cr. *Cash paid.*					
When received.	Of whom received.	On what account received.	Amount.			When paid.	To whom paid.	On what account paid.	Amount.		
			£	s.	d.				£	s.	d.
						Articles from the Farm consumed (Amount of).					
						When.	By whom.	What Article.	£	s.	d.
		Total received						Total paid			

4. *Management of Arable Land.*

No. of Years.	What Year.	What Crop.	Acres.	When begun.	PREPARING.																				
					Ploughing, Harrowing, Rolling.						*Manure.*						*Sowing Seed.*					
					No. of Men.	Days.	At per Day.	Amount.			Sort.	Quantity.	Price.	Amount.			Sort.	Quantity.	Price.	Amount.		
								£	s.	d.				£	s.	d.				£	s.	d.

5. *Management of Pasture Land.*

No. of Years.	What Year.	*How many Head of Cattle fed.*								*Produce of Hay, &c.*												Posted to Folio.	
		Oxen.	Horses.	Sheep.	Cows.	At per Head.	Amount.			When begun.		No. of Hands.	Amount paid.			How many Loads, at per Load.			Amount.				
							£	s.	d.				£	s.	d.				£	s.	d.		

6. *Management of Woodland.*

No. of Years.	What Year.	*Quantity Bark.*									*Underwood.*							*Timber Sold.*							
		No. of Men.	At per day.	Amount.			Quantity.	Price.	Amount.			Cost cutting down.		Quantity sold	Amount.			Sort.	Quantity.	Price.	Amount.			Posted to Bark and Timber.	Underwood.
				£	s.	d.			£	s.	d.				£	s.	d.				£	s.	d.		

7. *Account of Crops.*

Sort.	Threshed.			Bought.			Sold.			Sown.			Consumed.			Where, and by whom consumed.					Where sown.				Ground.		
	Qrs.	Bush.	£s.d.	Qrs.	Bush.	£s.d.	Qrs.	Bush.	£s.d.	Qrs.	Bush.	£s.d.	Qrs.	Bush.	£s.d.	Sort.	By whom.	Bush.	Pecks.	£s.d.	No. of Field.	Qrs.	Bush.	£s.d.	Bush.	Pecks.	£s.d.
Wheat																											
Barley																											
Oats																											
Hay																											
Potatoes																											

8. *Dairy Account of Milk, Butter, and Cheese.*

		Sunday.		Monday.		Tuesday.		Wednesday.		Thursday.		Friday.		Saturday.		Total Price.		Amount.		
		Qts.	Pts.	Qts.	Pts.	Qts.	Pts.	Qts.	Pts.	Qts.	Pts.	Qts.	Pts.	Qts.	Pts.	*s.*	*d.*	£	*s.*	*d.*
Milk.	Milked																			
	Made into Butter & Cheese																			
	Consumed																			
			lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.					
Butter.	Made																			
	Sold																			
	Consumed																			
Cheese.	Made																			
	Sold																			
	Consumed																			

9. *Stock Account.*

Increase and Decrease of Live Stock.									*What Part of the Farm occupied by the Cattle.*					
Description.				Increase by		Decrease by		Total.	Date when sent in.	When taken out.	Number and Description of Cattle.	Number of the Field.	Nature of the Crop in the Field.
			No.	Purchase.	Birth.	Death.	Sale.						
Sheep.	Rams	Spaniards											
	Ewes												
	Wethers												
	R. Lambs	Spaniards											
	E. Lambs	Ditto											
Cattle.	Bulls												
	Cows												
	Oxen												
	Heifers												
	B. Calves												
	C. Calves												
Pigs.	Boars												
	Sows												
	Barrows												
	Pigs												
Horses.	Horses												
	Mares												
	Colts												
Poultry and Eggs.	Turkies												
	Poults												
	Fowls												
	Chickens												
	Geese												
	Goslings												
	Ducks												
	Ducklings												
	Pigeons												
	Eggs												

No. III.—*On the Making of Watering Ponds, as practised by Robert Gardener, of Kilham, in the East Riding of Yorkshire.*

VARIOUS modes of making ponds have been adopted, with a view of simplifying the process, and lessening the expence; but *the improved practice,* invented by Robert Gardener, of which the following is a description, will be found to answer in almost any situation, in any country where the materials can be had.

Let a circle be marked on the ground sixty feet in diameter, more or less, as the person chooses, or the size of the pasture may require a supply of water, and if of that diameter, let it be hollowed out into the shape of a bason or bowl, to the depth of seven feet in the centre; when the surface of this hollow has been raked smooth, let it be well beaten over, so as to reduce it into as even, uniform, and firm a surface as the nature of the ground will admit of; on this, well slacked and skreened lime, must be uniformly spread, with a riddle, to the thickness of two or three inches; the more porous or open the ground, the greater will be the quantity of lime required: this lime must then be slightly watered, to make it adhere firmly to its place, and great care must be taken, to spread it equally, so that no place may remain uncovered, as on the lime, depends more than any thing else, the success of the work. On this lime must be laid a bed of clay, to the thickness of about six inches, which being moistened sufficiently to render it ductile, is to be beaten with mallets or beetles into a compact solid body, capable of being trod upon without impression or injury. Great care is to be taken in laying on uniformly this mass of clay, and beating it into a compact body; for which purpose, no more must be spread at a time upon the lime, than can undergo the beating, while it retains a proper temper or consistence for the purpose: after the whole is thus finished, it is gone over several times by the beaters, and sprinkled each time with water, and care is taken, to prevent any cracks being formed, which might entirely destroy the power of retention.

Pure brick-clay is not required, but any tenacious earth, that by beating will become a solid compact body, will answer the purpose. As soon as this operation has been duly performed, the whole surface of the clay is covered, to about the thickness of a foot, with broken chalk, fine gravel, or the chippings of mouldering stone, or limestone, to prevent any injury being done by the treading of the cattle. It is necessary to observe, that coarse stones must not be made use of, as they are liable to be displaced by the treading of cattle. They are also liable to be pressed into, or through the bed of clay, or to be rolled down to the bottom of the pond; under all which circumstances, the beds of clay and lime are liable to be broken, and the water consequently let out of the

pond. Sometimes the clay is covered with sods, the grass side being laid downwards, as a support to the gravel, by which some saving of covering may be made; or several inches thick of common earth is laid upon them, or upon the clay without the sods, by way of bed for the covering, where gravel, or such like materials may be scarce, by which something may be also saved.

After the clay has been well beaten, some workmen water the surface of it, and fold sheep or pigs, for a considerable time upon it; the treading of which, is found to be serviceable in rendering it more compact.

Some people, instead of using slaked lime, have good mortar, made of lime and sand, well worked together, and cover the surface of the ground with it, to the thickness of about an inch: this, if carefully done, is thought to be the most effectual mode of rendering the bottom retentive; but the mortar is liable to crack before the clay gets bedded over it, which must be carefully guarded against. Ponds have been made, where a coat of mortar has also been spread over the surface of the clay, as well as under it, an approach perhaps as near as possible to perfection: but where lime bears an high price, the expence is thus considerably augmented.

The best season for making these ponds, is thought to be in autumn, as they are then likely to be filled the soonest, and the least liable to crack before they are filled. Should the weather prove dry at the time they are finished, it is well to cover their surface with straw, or litter, to hinder them from cracking.

These ponds are usually made at the foot of some declivity, where, after heavy rains, a slight run of water may be conveyed into them, from some road, or other firm surface; but many are placed without any such assistance for filling, or with very little, it being found, that the rain that falls upon their surface is, in general, sufficient for a supply, after they have been once filled. As it is desirable to get them filled as soon as possible after they are finished, snow is frequently collected and heaped upon them, if possible in large quantities, the first winter after they are finished for that purpose.

Ponds of this kind, are usually made by what may be called professional people; men who go about for the purpose, and are chiefly or entirely engaged in it, and usually contract for the job. One of the diameter of sixty feet, and depth of six feet, may in most situations be executed for about 15*l.*; one of forty-five feet by five feet, for 10*l.* or 12*l.*; but some allowance must be made for the different prices of lime, or the distance it may be necessary to convey it, as well as the clay, or other materials for the work. A pond of sixty feet diameter, by six feet deep, will contain upwards of 700 hogsheads of water; one of forty-five feet by five feet, near 400 hogsheads—a vast supply, when obtained at so small an expence.

Experience now of many years, and the universal use of these

ponds in this district, wherever wanted, have proved them, when carefully made, so effectually to retain water,—to preserve it of so good a quality, when not dirtied by the treading of cattle,—and to be applicable to so many cases, that they cannot be too strongly recommended in all high exposures, where water may be much wanted, or in all other situations, where the water may be of bad quality: they are equally applicable to our dry wolds, downs, and heaths, which are without water, as to every fenny tract which has too much of it, but of a brackish or unwholesome quality.—*North Riding Report*, p. 243.

No. IV.—*On the Improved System of Summer Fallow, as practised in the Lothians, and the Advantages of the Grubber; by Mr. Robert Hope, an experienced Farmer at Fenton, in East-Lothian.*

NOTWITHSTANDING the objections which have been urged to the practice of occasionally summer fallowing land, yet its advantages, *on clay soils*, are now so well understood, and so universally admitted, by the most intelligent farmers in Scotland, as absolutely necessary for the profitable occupation of strong wet soils, that it becomes a matter of the greatest importance, to ascertain the most economical, as well as the most effectual mode of conducting that important operation:—important, in so far as it is well known, that in proportion to the judgment and accuracy with which it is performed, the success and value of all the various crops, throughout the succeeding rotation, necessarily depend.

In those districts in Scotland, where summer fallowing is carefully executed, the ground intended for that process, is ploughed in the winter, as early as may be convenient, when the ridges generally are, and ought always to be, gathered up; by which means, the whole furrows are laid completely open, and the field, after the cross furrows (*grips*, or *gaw* furrows), are cleared out with the spade, is left drier during the winter, than what possibly can be obtained by any other mode of ploughing. The next step is, to give the ground a second ploughing, immediately after the spring crops are sown (it being understood, that the ground is thoroughly dry at the time), when the ridges ought to be cloven down. The third ploughing, with a deep furrow, is to be given directly across the ridges, by which the soil is so far broken, as to be susceptible of being effectually operated upon by the harrows, which, with the roller, are then vigorously applied, till the soil is so far reduced, as to allow every root-weed upon the surface, to be picked off by the hand. After this, that valuable implement the *grubber*, or scarifier, is used with the greatest advantage, as an assistant to the plough, in facilitating the thorough cleaning of the soil; for by

passing it once, twice, or even thrice, over the field, in proportion as root-weeds are abundant, taking care, at the same time, to give a slight harrowing, and attentively to pick up every root-weed that appears, every time that the grubber has gone over the field; the soil, to the depth of from four to six inches, will be completely cleared of every weed that was within reach of the coulters of the implement. The land is then ploughed a fourth time, when the ridges are once more gathered up, after which the harrows are applied, and the roller, if necessary, till the soil is again rendered fine enough to part with the root-weeds. When these are carefully picked off, the grubber is used as formerly, and the soil is soon made perfectly clean of every weed that may have infested it. Dung, lime, or compost, may then be applied with propriety, where necessary.

In regard to the expence attending this operation, it must depend upon various circumstances—as the nature of the soil, whether it be stiff, or tolerably free; whether the ground be in medium condition, or very much exhausted; or whether the weather be wet or very dry; all of which make a great difference in the charges necessary. It is impossible therefore to give a statement which will correspond exactly with every individual case or situation. The following estimate is given, as applicable to a moderately stiff soil, in tolerable condition, with nothing uncommon in the state of the weather; it being understood, that when these circumstances are materially altered, the expences must likewise vary in proportion.

Average Expence of Summer Fallowing an English Acre of strong Clayey Soil.

	£	s.	d.
The three first ploughings, 10*s.* each	1	10	0
Two double harrowings	0	3	4
Rolling	0	2	0
Two double harrowings	0	2	6
Hand-picking weeds	0	1	6
Grubbing	0	3	6
One double harrowing	0	1	3
Hand-picking weeds	0	1	0
Fourth ploughing	0	8	0
One double harrowing	0	1	3
Rolling	0	1	8
One double harrowing	0	1	3
Hand-picking weeds	0	0	9
Grubbing	0	3	0
One double harrowing	0	1	3
Hand-picking weeds	0	0	9
Fifth and last ploughing	0	8	0
Total expence	£3	11	0

It thus appears, that summer fallowing an acre of land, on an average, occasions an expence of 3*l.* 11*s.*; and had the grubber not been used, one or two additional ploughings would have been necessary, which, though they would hardly have rendered the soil so clean, yet would have added at least 9*s.* 6*d.* to the expence, the whole then amounting to 4*l.* 0*s.* 6*d.* per acre; yet considerable as that difference is, it is not the whole benefit which is derived from the use of that implement in the fallowing process; for it is well known, that expedition is of the utmost importance in the conducting of rural operations; and as one man, with four horses in the grubber, will go over the same ground in a day, as six men and twelve horses can do with the plough; hence in this point of view alone, the value of that implement is of the highest importance. In cases where there is but a small quantity of root-weeds, such as *knot-grass,* the saving of labour is still more considerable, as the grubber, going but once over the ground, is frequently found as effectual, in bringing these to the surface, as one additional ploughing.

The grubber is likewise of use in other farming operations. In the preparation of the ground for turnips, that implement is in general found equally efficacious; the only exception being, where the soil is uncommonly soft (as in some instances is the case upon the sea-coast), and at the same time remarkably full of root-weeds; under such circumstances, the grubber is very liable to choke up; but in by far the greater number of situations where turnips are cultivated, that objection will not occur.

Where lime or compost has been applied, the value of the grubber, in working these valuable substances into the soil, is also of very great importance, for by passing it once along, and then across the ridges, the lime or compost is thoroughly mixed, without being thrown too deep into the ground, as frequently happens, when the plough is used for that purpose. After the grubber, however, has been used, the field ought to be ploughed, so that the ridges may be brought into such a form, as to facilitate the descent of rain-water into the furrows.

Another most important use of the grubber is, that it may be employed with great advantage, on all lands ploughed in autumn, or early in winter, to be sown in spring, for by passing it once over the field, the soil is effectually stirred and loosened to the depth of five or six inches, without burying the fine mellowed surface, or bringing up fresh soil, to run into hard and stubborn clods, which almost constantly happens, when the plough is used in such cases, in wet or clayey soils. Oats or barley may be thus sown, with much less expence, and consequently with more profit.

Grubbers, on an improved principle, are now made in the Lothians, entirely of cast iron, and at a moderate expence. It is an implement that cannot be too strongly recommended.

The great objects of a fallow, cleaning the land of weeds, and pulverising the soil, may likewise be greatly facilitated, by the

use of an instrument called the *Binot* in Flanders, an engraving of which is annexed.

In some respects it resembles a plough, with a double share, and two mould-boards; but, on the Continent, it has no coulter. It is not a dear instrument, for the one purchased in the Netherlands, to send to England, for the inspection of the Board of Agriculture, cost only 60 francs, or 2*l.* 13*s.* 4*d.* sterling, but then it is very coarsely made. Some farmers have three binots to eight ploughs of different sorts; some two binots to five ploughs, and some two binots to four ploughs. Only one ploughman and two horses are employed. It can be made to plough to different depths, but in general, the furrow is from five to six inches. Such is the importance of this instrument, that several most intelligent farmers in Brabant, have declared, it was not in their power to cultivate their land without it, to the same degree of perfection.

In the Walloon country, in almost every case, the land is broken up, either in autumn, winter, or spring, by the binot. If the soil be foul, they employ it two or three times, for the purpose of cleaning it thoroughly. By using this instrument, the land is not turned over, as by the plough, and the weeds buried; but the soil is elevated into small ridges, by means of which the couch, and other root-weeds, are not only cut, but they are exposed to the frost in winter, and to the drought of spring; and when the land becomes dry, which it does quickly when thus elevated, these weeds are collected by the harrow, by a trident (or large pitch-fork), by a rake, or by the hand; for weeding is an operation on which no expence is spared in the Netherlands. Root-weeds, when thus collected in the dry period of the spring, are either burnt, or mixed in a compost with hot lime. After the binot, the land is always ploughed for the seed furrow.

In addition to this important advantage, even the heaviest land is rendered tender and friable by these operations, and loses that hardness, which clayey soils are apt to acquire, after having been long cropped, without being occasionally completely pulverised.

Another advantage attending the binot is, that it is less expensive in its operations. Using it once, is not only equal to two ploughings, but the binot goes over a greater extent of land in the same space of time, and with the same strength of cattle. The saving of even one ploughing is of great importance; but in many cases, by the use of the binot once, two ploughings might be saved.

The binot has also been found of great use, in the first breaking up of waste-land, not incommoded with stones, and in raising a crop of potatoes.

The above account of the advantages of the binot, was transmitted in French, to some intelligent farmers in the Walloon country, who entirely concurred in it. Its shape has been greatly improved by an ingenious artist in this country*, and there can be

* The improved binot, and other useful instruments, may be had at the

no doubt of its becoming a most valuable addition to our instruments of husbandry.

No. V.—*Calculations to prove the Superiority of cultivating Winter Tares, instead of a Summer Fallow, even on strong Lands. By John Middleton, Esq.*

IN order to prove the superiority of a crop of tares, above the system of summer fallow, the following account has been drawn up, of the expence attending that operation, on tough, gluey clay, particularly in chalky districts, with, or without a mixture of stones.

The first ploughing should take place in autumn, as soon after harvest as the other works can admit of it. The clay assumed, is met with upon the chalk hills; and early in autumn they are known to require from four, to five or six horses, a man and a driver to each plough. On some occasions, six horses, two men, and a youth of sixteen or eighteen years old, have all labour enough on the first ploughing of a corn stubble, on such soils.

	£	s.	d.
Charge each of the horses, including harness and implements, 3*s.* 6*d.* and the men at 2*s.* per day, by which ploughing one acre will cost at least - -	1	6	0
In the course of next summer there will be two other ploughings, which may be done at 20*s.* per acre,	2	0	0
And two other ploughings with three horses, may be done at 13*s.* 6*d.* per acre, or - - -	1	7	0
Working the grubber, and the harrows, and rollers, as well as raking and picking the couch, and burning it in heaps. These ought to be continued till the land be rendered quite free from root-weeds, - -	1	0	0
Opening water-furrows and grips, - - -	0	3	0
Fences, gates, stiles, and destroying vermin, - -	0	4	0
Manure, including lime, cartage, and spreading it, an average of - - - -	0	11	0
Seed wheat, three bushels, liming it, carrying it to the land, and sowing it, - - - -	1	7	0
Boys, with powder and shot, to keep the birds off, -	0	2	0
The expence of the crop when fit for reaping, is per acre,	£8	0	0
This estimate is for land of the most clayey kind, or for clay and flints; therefore the labour is great, and the expences are high. But a strong loam would be followed equally clean for less money by 1*l.* or for 7*l.*			
Carried over	£8	0	0

Agricultural Repository, Winsley-street, opposite to the Pantheon, London; and at Weir's manufactory, 66, Wells-street, Oxford-street. The price of the binot is five guineas.

Brought forward	£8	0	0
The like after a crop of potatoes, tares or clover, as is shewn under wheat, - - -	3	0	0
Remains the difference of expence from 4*l.* to	£5	0	0
And a crop of tares may be previously obtained, which, in the support of cattle, upon any farm considerably distant from market, pay every expence attending them, and yield a profit per acre, of more than -	2	0	0
	£7	0	0

Thus it appears, that the real money difference, which tares have over a summer fallow, is from 6*l.* to 7*l.* per acre; and tares have an additional advantage of importance over fallows, in manuring the land plentifully, through the medium of cattle and sheep; which is worth from 3*l.* to 5*l.* per acre.

In order to discover the real expence of a crop of wheat, it should be considered that the cultivation varies with the soil, and including seed, it costs as aforesaid, from 7*l.* to 8*l.*

	£	s.	d.
To which add for tithes, per annum, - -	0	3	0
Rent supposed to be per annum, - -	0	10	0
Repairs, taxes, assessments, losses, insurance, &c. &c. as much as the rent, - - -	0	10	0
Profit, including interest, ditto*, - - -	0	10	0
Together,	£1	13	0

One year at 1*l.* 13*s.* is 3*l.* 6*s.* for the two years, on land at 10*s.* per acre. Add this 3*l.* 6*s.* to what has just been mentioned as the expence of cultivation, namely, 8*l.*; and we have 11*l.* 6*s.* as the whole cost of obtaining a crop of wheat by summer fallowing, on a strong clay-soil, without any purchased manure. This sum exceeds the price of 22 bushels of wheat, and that is more than would be grown on such bad and exposed land. To the expence of 11*l.* 6*s.* add the value of manuring the soil, by feeding a crop of tares upon it, which may be stated at from 3*l.* to 4*l.* and even 5*l.* per acre, and there results from 14*l.* 6*s.* to 16*l.* 6*s.* per acre, as the superiority which a crop of tares has over a summer or naked fallow.

* If it should be objected to this article being part of the estimate, it may be said in support of it, that the farmer is certain to subsist on the produce of his farm. This is a daily expence which cannot be avoided, and he will obtain it whether he may be able to pay other things or not, therefore it might be the first item in the estimate. The second would be repairs, losses, taxes, &c. Thirdly, tithes in kind, or not. Lastly, rent. Many of the other articles are irresistible, and all of them more urgent than rent. Every deficiency seems to fall upon rent.

As the question of summer fallows, has been a subject of much debate, it is thought advisable to introduce in this place one more estimate, and that is selected for land, which may be worth a rent of 20*s.* per acre.

	£	s.	d.
Tithes both great and small, per annum, - -	0	6	0
Rent per annum, - - - -	1	0	0
Repairs, taxes, assessments, losses, insurance, and many other things to as large an amount as the rent, -	1	0	0
Profit, including interest, ditto*, - -	1	0	0
	£3	6	0

One year at 3*l.* 6*s.* is 6*l.* 12*s.* for the two years which a summer fallow, and a crop of wheat, occupy the ground. Add this 6*l.* 12*s.* to what it would cost in tillage and seed, 7*l.* 10*s.* (as this soil may be supposed less stubborn than in the former case, which required an expenditure of 8*l.*, we will state this at 7*l.* 10*s.*) and we have 14*l.* 2*s.* as the cost of the crop. That is the value of about 28 or 30 bushels of wheat, which would not be grown on such land. To these expences, which amount to 14*l.* 2*s.* per acre, add the value of manuring the soil as aforesaid, from 3*l.* to 5*l.* and the result is, from 17*l.* 2*s.* to 19*l.* 2*s.* as the superior value which tares have over a naked summer fallow, on this kind of soil.

Mr. Middleton has estimates of this kind for land of every quality; but these are considered to be sufficient to shew, what they all demonstrate, that a summer fallow, in all cases, is attended with more expence than can be repaid by a succeeding crop of wheat. It is well known, indeed, to that intelligent class of husbandmen and surveyors, who are much employed in the valuation of farmers' crops, that a summer fallow costs as much or more than the succeeding crop of wheat is worth. A summer fallow, therefore, renders two years, in every rotation, wholly unprofitable to the farmers, and very frequently it is a considerable loss to them.

The raising clean, smothering, green crops, and feeding stock with them upon the land, is not only much more profitable, as far as relates to the value of the crop substituted in lieu of a fallow, but is also a more effectual method of procuring large crops of wheat, or any other corn which may succeed the green crop.

By fallowing, not only one year's rent, taxes, assessments, and labour, are expended, but likewise the remains of manure, contained in the soil, are rendered less fit to promote the growth of subsequent crops. Fallowing, therefore, should be practised but sparingly: its only use is in occasionally destroying root-weeds, and insects. These objects being attained, recourse should never be had to the same operation, until root-weeds, or insects, have gained such possession of the land, as to make fallowing necessary for their

* See Note in preceding page.

destruction. These cases, which are supposed to render fallowing necessary, never happen to a good farmer. A new tenant frequently finds, at the commencement of his term, his arable land infested with weeds, occasioned by his predecessor's neglect, and in such a case, if the land be nearly a pure clay, it may be advisable to cleanse it by a summer fallow; but all the lighter soils may be cleared of both root and seed weeds, by the cultivation of tares, turnips, and potatoes. Land of every description, which has been made thoroughly clean, may be so continued in perpetuity, without ever resorting to fallow a second time, as the same is proved by the constant practice of all the kitchen gardeners*, the farming gardeners (those who till their land by the plough), the potatoe growers, and the cow-keepers, who rent arable land, for the purpose of growing tares, turnips, and cabbages.

The smothering and hoeing crops of tares, turnips, potatoes, cabbages, savoys, cole, hemp, and other plants which cover the ground, and cause a stagnation of air, preserve the moisture of the soil, and promote the putrefaction and decomposition of such animal and vegetable matter, as may be contained in the soil, are more likely to prove economical and beneficial than any system of fallowing †.

In general, the farmers of both England and Scotland, who include a naked fallow in their rotation, obtain less profit than the same men on the same land would do if they were to raise winter tares, or cole, or savoys, and then cleanse the soil as well as the soil and the season may permit, as will be demonstrated in the paper on the comparative value of several rotations.

* Good gardeners are not satisfied with any degree of cleanliness, short of the entire destruction and removal of every morsel of couch grass. This is an useful lesson to the farmers, and they ought to act fully up to it, otherwise they are at a continual expence to repress the root-weeds, instead of one considerable exertion, which would destroy them for ever.

† In Sussex, they substitute a double crop of tares, first the winter, and next the spring sort, instead of a fallow for wheat, even on strong soils, with great success, feeding, by that means, a great number of stock, and obtaining much manure, that would not otherwise have been got.—*Sussex Report*, p. 105.

No. VI.—*Proofs of the unfavourable Idea entertained by British Statesmen, of the ability of this Country, to raise a sufficiency of Grain for its own Consumption, and of the little idea they entertained, of the importance of Agriculture, previous to the Establishment of a National Institution for promoting its Improvement.*

IN the year 1790, the Committee of Privy Council appointed to inquire into all matters relating to trade, took into its consideration the laws regarding the exportation and importation of grain, and presented a Report to His Majesty upon the subject, which is drawn up with much ability, although with such little idea of the *agricultural resources of the country*, that we are told, we must depend for a part of our consumption, not on an increased cultivation at home, not even on the produce of Europe, but on the harvests of America. Yet in the year 1808, as appears from the Custom-house accounts, we exported corn to the value of 470,431*l.* and imported only to the amount of 336,460*l.* consequently Great Britain became again an exporting country, and for that year at least, with the assistance of Ireland, was independent of foreign nations for corn.

In the year 1791-2, Mr. Pitt explained, in a speech on the state of the nation, what appeared to him the causes of the general increase of the national prosperity which had taken place at that time. That speech has been very ably commented upon by Mr. Arthur Young, in his Annals of Agriculture*. Mr. Young was shocked to find, in that speech, the greatest, dearest, and most important interests of the kingdom, totally and contemptuously overlooked, as of no sort of consequence in the great scale of national prosperity. A financier, he observes, in giving a general view of the national resources, and dwelling with pride on the public revenue, does not think that agriculture, which, even then paid twelve millions sterling *per annum*, in public burdens, worthy even of being named amongst the sources of prosperity!

Mr. Young also remarked, "that the agricultural interests of this kingdom, perhaps never found themselves placed in so contemptible a position, as in this speech of the Minister, who, wishing to make the utmost parade of every circumstance that would count in a catalogue of national advantages, totally overlooked every thing connected with land." Mr. Young little expected, in the course of a few months, to be Secretary to a Board of Agriculture, established with the concurrence of the very Minister, by whom that speech had been delivered.

* Vol. xvii. p. 369.

As late as the year 1796, another British statesman, distinguished for political information (Lord Auckland), delivered a speech in the House of Lords, which was afterwards published, and of which the following is an extract:

"To what, under the protection and favour of Divine Providence, shall such prosperity be ascribed?—to our naval superiority and successes; to our conquests in the East and West Indies; to the acquisition of new markets; to the enterprising spirit of our merchants; to the improvements of our manufacturers; to the energy of our countrymen in arts and in arms; to the union of liberty with law; to the national character, cherished by, and cherishing the principles of our inestimable constitution; that constitution, which it has been the object of our enemies to destroy, by means and effects utterly destructive to themselves; that constitution, which it is the great purpose of our struggles, in this just and necessary war, to preserve and to maintain*."

Not one word of agriculture in this whole paragraph, intended to enumerate the causes to which our prosperity was to be ascribed. We have hitherto indeed been too much considered as a mere commercial nation; whereas every country possessed of an extensive and fertile territory, ought to account the cultivation of its soil, as the surest foundation of its prosperity, and the best entitled, of all the sources of that prosperity, to the peculiar attention of an enlightened government. Such a government will be ready, at all times, to remove every obstacle to improvement; if not to promote, by public encouragement, those unceasing exertions, by which alone, the whole territory of a great country, can be rendered, what it ought to be—one uninterrupted scene of industry and cultivation.

* See the substance of Lord Auckland's Speech in the House of Lords, the 2d day of May, 1796. London: printed for J. Walter, Charing-cross.

No. VII.—*An Account of the Bills of Enclosure passed in the course of* 40 *years, in two periods of* 20 *years each, namely, from* 1774 *to* 1793, *prior, and from* 1794 *to* 1813 *inclusive, posterior to the establishment of the Board of Agriculture.*

1774	59	1794	73
1775	38	1795	76
1776	55	1796	70
1777	88	1797	86
1778	61	1798	52
1779	66	1799	65
1780	35	1800	82
1781	22	1801	49
1782	17	1802	158
1783	13	1803	92
1784	12	1804	52
1785	22	1805	68
1786	25	1806	76
1787	21	1807	91
1788	34	1808	92
1789	31	1809	122
1790	23	1810	107
1791	34	1811	133
1792	35	1812	156
1793	58	1813	183
	749		1,883
Average	37	Average	94

There cannot be stronger evidence, of the advantages derived from the establishment of a Board of Agriculture; nor a better proof of a general spirit of improvement, having been thereby excited, than what this table furnishes. The *extra* Bills of Enclosure amounted to 1134; and as each bill, on an average, would promote the improvement of at least 2000 acres, hence 2,268,000 acres in all, must have been thus improved, in England alone, in these 20 years.

No. VIII.—*Description of the Mode of Hay-making in Middlesex, of Natural Grass. By John Middleton, Esq.*

THIS branch of the rural art has, by the farmers of Middlesex, been brought to a degree of perfection, altogether unequalled by any other part of the kingdom. The neat husbandry, and superior

skill and management, that are so much, and justly, admired in the *arable* farmers of the best cultivated districts, may, with equal justice and propriety, be said to belong, in a very eminent degree, to the *hay* farmers of Middlesex; for by them, may very fairly be claimed the merit, of having reduced the art of making good hay to a regular system; which, after having stood the test of long practice and experience, is found to be attended with the most desirable success. Even in the most unfavourable weather, the hay made according to the Middlesex manner, is superior to that made by any other method, under similar circumstances. It is to be regretted, that this very excellent practice has not yet, except in a very few instances, travelled beyond the borders of the county. But as it most justly deserves the attention and imitation of farmers in other districts, I shall, for their information, endeavour minutely to describe the method in which the Middlesex farmers make their hay.

In order that the subject may be more clearly understood, I shall relate the particular operations of each day, during the whole process, from the moment in which the mower first applies his scythe, to that in which the hay is secured either in the barn or in the stack. Before I enter more immediately on this task, I would just premise a few observations, viz. when the grass is nearly fit for mowing, the Middlesex farmer endeavours to select the best mowers, in number proportioned to the quantity of his grass, and the length of time it would be advisable to have it in hand; which having done, he lets it out, either as piece-work, or to be mown by the acre *.

About the same time he provides five hay-makers (men and women †), to each mower. These last are paid by the day, the men attending from six till six; but the women only from eight till six. For an extra hour or two in the evening, when the business requires dispatch, they receive a proportionate allowance.

The mowers usually begin their work at three, four, or five o'clock in the morning, and continue to labour till seven or eight at night: resting an hour or two in the middle of the day.

Every hay-maker is expected to come provided with a fork and a rake of his own; nevertheless, when the grass is ready, and labourers scarce, the farmer is frequently obliged to provide both; but for the most part, only the rake.

Every part of the operation is carried on with forks, except clearing the ground, which is done with rakes; and loading the carts, which is done by hand.

Having premised so much, I now come to the description of the business of the

* Each man mows from one acre and a half to an acre and three quarters per day; some there are, who do two acres per day, during the whole season.—*J. M.*

† Including loaders, pitchers, stackers, and all others.—*J. M.*

First Day.—All the grass mown *before* nine o'clock in the morning, is tedded, in which great care is taken, thoroughly to loosen every lump, and to strew it evenly over all the ground*. Soon afterwards it is turned, with the same degree of care and attention; and if, from the number of hands, they are able to turn the whole again, they do so, or at least as much of it as they can, till twelve or one o'clock, at which time they dine. The first thing to be done after dinner, is to rake it into what are called *single* windrows †; and the last operation of this day is to put it into grass-cocks.

Second Day.—The business of this day commences with tedding all the grass that was mown the first day *after* nine o'clock, and all that was mown this day *before* nine o'clock. Next, the grass-cocks are to be well shaken out into staddles (or separate plats) of five or six yards diameter. If the crop should be so thin and light, as to leave the spaces between these staddles rather large, such spaces must be immediately raked clean, and the rakings mixed with the other hay, in order to its all drying of an uniform colour. The next business is to turn the staddles, and after that, to turn the grass that was tedded in the first part of the morning, once or twice, in the manner described for the first day. This should all be done before twelve or one o'clock, so that the whole may lie to dry while the work-people are at dinner. After dinner, the first thing to be done is, to rake the staddles into *double* windrows ‡; next, to rake the grass into *single* windrows; then the double windrows are put into bastard-cocks; and lastly, the single windrows are put into grass-cocks. This completes the work of the second day.

Third Day.—The grass mown and not spread on the second day, and also that mown in the early part of this day, is first to be tedded in the morning; and then the grass-cocks are to be spread into staddles, as before, and the bastard-cocks into staddles of less extent. These lesser staddles, though last spread, are first turned,

* The following observations on the Middlesex method of hay-making, were obligingly communicated by Thomas Skip Dyot Bucknall, Esq. M. P.

"By this regular method of tedding grass for hay, the hay will be of a more valuable quality, heats more equally in the stack, consequently not so liable to damage, or fire; will be of greater quantity, when cut into trusses, and will sell at a better price; for when the grass is suffered to lay a day or two before it is tedded out of the swath, the upper surface is so dried by the sun and winds, and the interior part is not dried, but withered, so that the herbs lose much, both as to quality and quantity, which are very material circumstances, at the price hay now fetches at market. An instance in point: the physic gardeners who attend to their business, are very careful, in the proper and equally drying their herbs, and they find their account in it."

† That is, they all rake in such a manner, as that each person makes a row, which rows are three or four feet apart.—*J. M.*

‡ In doing which, every two persons rake the hay in opposite directions, or towards each other, and by that means form a row between them of double the size of a single windrow.—Each of these double windrows is about six or eight feet distant from each other.—*J. M.*

then those which were in grass-cocks; and next the grass is turned once or twice before twelve or one o'clock, when the people go to dinner as usual. If the weather has proved sunny and fine, the hay which was last night in bastard-cocks, will this afternoon be in a proper state to be carried*; but if the weather should, on the contrary, have been cool and cloudy, no part of it probably will be fit to carry. In that case, the first thing set about after dinner, is to rake that which was in grass-cocks last night into double windrows; then the grass which was this morning spread from the swaths, into single windrows. After this, the hay which was last night in bastard-cocks, is made up into full-sized cocks, and care taken to rake the hay up clean, and also to put the rakings upon the top of each cock. Next, the double windrows are put into bastard-cocks, and the single windrows into grass-cocks, as on the preceding days.

Fourth Day.—On this day the great cocks, just mentioned, are usually carried before dinner. The other operations of the day are such, and in the same order, as before described, and are continued daily, until the hay harvest is completed.

In the course of hay-making, the grass should, as much as possible, be protected both day and night, against rain and dew, by cocking. Care should also be taken to proportion the number of hay-makers to that of the mowers, so that there may not be more grass in hand at any one time, than can be managed according to the foregoing process. This proportion is about twenty hay-makers (of which number twelve may be women), to four mowers: the latter are sometimes taken half a day to assist the former. But in hot, windy, or very drying weather, a greater proportion of hay-makers will be required than when the weather is cloudy and cool.

It is particularly necessary to guard against spreading more hay, than the number of hands can get into cock the same day, or before rain. In showery and uncertain weather, the grass may sometimes be suffered to lie three, four, or even five days, in swath. But before it has lain long enough for the under side of the swath to become yellow (which, if suffered to lie long, would be the case), particular care should be taken, to turn the swaths with the heads of the rakes. In this state, it will cure so much in about two days, as only to require being tedded a few hours, when the weather is fine, previous to its being put together and carried. In this manner, hay may be made and put into the stack at a small expence, and of a moderately good colour; but the tops and bottoms of the grass are insufficiently separated by it.

There are no hay-stacks more neatly formed, nor better secured, than those made in Middlesex. At every vacant time, while the stack is carrying up, the men are employed in pulling it, with their hands, into a proper shape: and, about a week after it is finished,

* It seldom happens in dry weather, but that it may be carried on the third day.—*J. M.*

the whole roof is properly thatched, and then secured from receiving any damage from the wind, by means of a straw rope, extended along the eaves, up the ends, and on each side of the ridge. The ends of the thatch are afterwards cut evenly below the eaves of the stack, just of sufficient length for the rain-water to drip quite clear of the hay. When the stack happens to be placed in a situation which may be suspected of being too damp in the winter, a trench, of about six or eight inches deep, is dug round, and nearly close to it, which serves to convey all the water from the spot, and renders it perfectly dry and secure.

It is of great advantage to the farmer, to give constant personal attendance on every party, directing each operation during the whole hay-harvest. The man who would cure his hay in the best manner, and at a moderate expence, must not only urge the persons who make the hay, the men who load the waggons, and those who make the stack, but he should be on the alert, to contrive and point out the manner in which every person may do his labour to the most advantage. Unless he does this, one moiety of the people in his hay-field will be no material use to him; and if he should be absent for an hour or more, during that time, little or nothing will be done. The farmers of Middlesex engage many hay-makers: some of them have been known to employ two or three hundred: such men find it necessary to be on horseback, and the work-people find them sufficient employment. A man of energy will make the most of every hour, and secure his hay while the sun shines: one of an opposite description lounges his time away, and suffers his hay to be caught in the rain, by which it is frequently half spoiled. Or if the latter should have the good fortune of a continuance of dry weather, his hay will be a week longer in the field than his neighbour's, and the sap of it dried up by the sun.

It is supposed that 400lb. of grass, on being dried into hay, wastes to 100lb. by the time it is laid on the stack; it is then further reduced, by heat and evaporation, in about a month, to perhaps 95; and between that and 90, I apprehend it continues through the winter. From the middle of March till September, the operations of trussing and marketing, expose it so much to the sun and wind, as to render it considerably lighter, probably 80: that is, hay which would weigh 90 the instant it is separated from the stack, would waste to 80 (in trussing, exposure on the road, and at market for about 24 hours), by the time it is usually delivered to a purchaser. During the following winter, the waste will be little or nothing: it is nearly obvious, that the same hay will weigh on delivery 80 in summer, and 90 in winter. From this circumstance, and others which relate to price, a farmer may determine what season of the year is the most advisable for him to sell his hay. I have known a gentleman have the hay of five years by him at one time; the price then rose, and he sold it to much

advantage; and I now know there are several farmers in this county, who have from one to two thousand tons of hay.

In the neighbourhood of Harrow, Hendon, and Finchley, there are many hay-barns capable of holding from 30 to 50, and some even 100 loads of hay. They are found to be extremely useful and convenient during a catching and unsettled hay-harvest, as a safe receptacle for the hay as fast as it becomes dry. In the very common case of approaching rain, when the hay is fit for carrying, every nerve is, or ought to be, exerted, to secure it as much as possible; and that is most effectually done, by getting all the carts and waggons loaded with it, and drawn into the barns: the rest of the hay must take its chance in large cocks. These barns are also of considerable utility for the reception of loaded carriages daily, a short time before night, where they are secure, and afford certain employment for the men the next morning, before breakfast, in unloading. Even in dull or damp mornings, the hay can be safely unloaded under the cover of these buildings, when it could not be done on to a stack in an exposed yard. I remember a morning of this kind which threatened rain, in which my neighbours durst not uncover their stacks, when, under the security of a hay-barn, I unloaded twelve carts and waggons before the men went to breakfast: the day turned out fine, and my people were all ready for the hay-field, where they re-loaded the carriages into the same barn before night.

In winter, and in all wet and windy weather, the barns afford safety to the broken cuts, and an opportunity of cutting, weighing, and binding hay; none of which operations could, at such a time, be performed out of doors. The farmers whom I have consulted on this subject, agree, that hay may be put together earlier, even by a day, in a barn, than it would be safe to do in a stack.

The expence of a hay-barn, which costs 100*l.*, generally saves, in straw and thatching, and its other advantages, the whole of its cost in three years. Indeed, I built one on oak posts, in the most complete manner, which holds 100 loads of hay, and am certain its savings equalled its cost in two years; but in this it was aided by the then high price of straw.

In the driest seasons, barns are a saving of 6*s.* or more per acre; and in wet seasons, the ready assistance which they afford in speedily securing the hay, has been known to make a difference in price of 20*s.* per load, on a small number of lands.

Close barns exclude the current of external air, which is, probably, the immediate cause of the ignition of the hot vapour, at the instant of its escape from the hay-stack. In the barn, this hot vapour, or steam, is confined in the empty space between the hay and the roof, until it has parted with so much heat, as to be incapable of taking fire, when it comes in contact with the external air, in its escape from the barn.

No. IX.—*On the Uses of Salt for Agricultural Purposes. By the Right Hon. Sir John Sinclair, Bart.*

As Parliament has resolved, that a reduction in the duties on Salt shall take place, for the purpose of ascertaining, by decisive experiments, its utility for agricultural purposes, it is proposed here, briefly to point out, in what respects in has already been found of advantage. The farmer will thus have some clue to direct his proceedings; and if the result of such experiments, as he may thence be induced to try, *prove highly satisfactory*, and the importance of Salt to Agriculture is confirmed, *beyond the possibility of doubt*, it may be the means of inducing Parliament, to lower the duties still farther, or to commute them entirely, that so great a source of national prosperity may not be impeded or curtailed.

It is the more necessary, thoroughly to investigate this subject, as there is no substance that could, in so many different respects, be rendered so useful to Agriculture, *as Salt:*—1. It operates as a manure to arable land;—2. It may be of use in promoting the fertility of waste land;—3. It is an effectual remedy against the smut;—4. It preserves the seed, when sown, from vermin;—5. It promotes the vegetation of oily seeds;—6. It increases the produce of pasture land, and meadows;—7. It improves the quality of hay;—8. It renders coarse food more nourishing, and moist food less injurious to cattle, and horses;—9. It preserves stock from disease, and improves their condition;—and, 10. It has a tendency to prevent the rust or blight in wheat.

1. *On Salt as a Manure to Arable Land.*—Though salt, if employed in large quantities, in its natural state, is hostile to vegetation, yet it operates advantageously, in various ways, when judiciously applied to arable land. In large quantities, it has a tendency, like every other excessive stimulus, to disorganize and destroy the vegetable substances with which it comes in contact; but in *moderate quantities*, it promotes the growth of vegetables, by enabling them to take up more nutriment, in a given space of time, and to perform their circulations and secretions with greater energy*.

The following are modes, in which it has been successfully made use of for the improvement of arable land.

1. In preparing the soil, *under the fallow process*, it is recommended, to sow from thirty to forty bushels of salt per statute acre, for the purpose of destroying the roots and insects in the soil, and breaking all the tough and adhesive clods which are found to be so

* Darwin's Phytologia, p. 336; Cheshire Report, p. 240.

troublesome in working the ground. This should be done in autumn, some time before the land is ploughed. The salt being thoroughly incorporated with the soil, during the spring and summer following, the strength of the salt would be so much reduced, when the seed is sown, that instead of injuring, it will promote vegetation; and the lands, it is said, will be found to produce a crop, superior to those under any other mode of cultivation; the advantage of which will be experienced for several succeeding years*.

It would be extremely important, to compare the produce and expence of a fallow, treated in this manner, or manured with lime.

2. Salt has likewise been advantageously applied *to crops*. R. Legrand, Esq. tried it twice on a barley tilth, sowing the salt at the rate of sixteen bushels per acre, immediately after the crop was covered by the harrow. The verdure, in spring, exceeded any thing he had ever seen, and the ripened appearance was whiter, by many shades, than he had ever beheld†. Mr. Hollinshead also recommends sowing sixteen bushels of salt per acre, on a crop of potatoes, as soon as they are covered with earth; and he maintains, that by the adoption of that system, alternate crops of wheat and potatoes, might be permanently produced on the same soil‡. These are modes of application, however, the utility of which ought to be tried by repeated experiments, before they can be confidently relied on.

3. It has been proved by Pringle, and Macbride, that though salt will, in large quantities, prevent putrefaction, owing to its antiseptic properties, yet that it has an evident tendency to promote the process, when used in small quantities. Hence the advantage of mixing it in moderate quantities with farm-yard dung§, and other animal and vegetable substances.

An experiment was tried in Cheshire, of mixing grass roots, and other rubbish harrowed off the land, with foul salt; it was then incorporated with other manures, and the effects of this compost, on a crop of barley and grass seeds, is said greatly to have exceeded the most sanguine expectations that had been formed of it||.

4. Salt, when applied in composts, is said to have been found a more beneficial manure even than lime. A farmer mixed up a quantity of refuse salt, with the earth taken out of water furrows, and another portion of the same earth with lime. Of the two, the vegetation of that part of the field, which had *the salt compost* laid upon it, was by far the healthiest and most vigorous¶.

* Hollinshead, on the Importance of Salt as a Manure, second edition, p. 17. It is said that Mr. Hollinshead devoted above twenty years of his life, to a scientific and practical enquiry into the uses of Salt as a Manure.—Sir Thomas Bernard's Tract on Salt, p. 279.

† Hollinshead, 2d edit. p. 12. ‡ Ditto, p. 19.

§ It may be advantageously strewed over farm-yard dung, when carried to the field.

|| Cheshire Report, p, 237. ¶ Ditto, p. 237.

5. In those parts of Cornwall, where the pilchard fisheries prevail, considerable quantities of old or condemned salt*, are used as a manure, mixed in compost, with earth, scrapings of roads, broken fish, sea sand, and stable dung. The quantity of salt allotted to an acre, thus mixed in compost, is about a ton, which may cost about ten shillings. The broken fish is considered to be the most valuable article, and the salt is accounted friendly to vegetation, in cases where it is thus used in a mild and modified state.

6. The most extraordinary circumstance, connected with the effects of salt on vegetation, takes place in the southern provinces of France. The surface of the ground on the sea-coast of those provinces, contains a number of saline particles. When the season arrives for cultivating that species of soil, the farmers find it necessary to sow, not only wheat, but a plant called *salicor*, or *kali*, which produces barilla. If a great quantity of rain falls from the month of April to that of June, the wheat prospers, the salt being washed down below the roots of the plants, leaving the saline particles remaining near the surface of the soil, in that state of equilibrium which is favourable to the vegetation of grain. On the other hand, if the weather is dry, and the salt remains near the surface, the *salicor* prospers, for it demands a great quantity of salt for its vegetation. Thus, when the grain prospers, the salicor perishes, and when it succeeds, the grain is destroyed†.

2. *Of Salt, as promoting the Fertility of Waste Land.*—Having, at the desire of the Board of Agriculture, written to an intelligent Correspondent in the Netherlands (M. Gillet of Brussels), to know whether the farmers there, had derived any agricultural advantages from the use of salt, I received in return, the following information, which explains how salt, when judiciously applied in compost, may promote the improvement of waste lands.

The Abbey of St. Pierre, at Ghent, before the Revolution, broke up about 150 English acres (fifty Flemish bonniers), of moor-land, near Oudenarde, and in order to procure manure, they adopted the plan of collecting all the heath-clods, or lumps the soil produced, into piles, and intermixed them with strata of salt. These piles were turned over once a year, for three years successively, and were then spread upon the land, which, by means of that manure, produced good crops for two years. Being let to farmers, the plan of using salt was given up, and the soil becoming unproductive, was planted with brushwood or coppice. It

* Sir Humphry Davy (Lectures, 4to edit. p. 295), states, that refuse Salt, which, however, likewise contains some of the oil and exuviæ of fish, has long been known, *as an admirable manure*, in Cornwall.

* "*Si le blé à bien vegeté, le salicor perit ; et il prospere, lorsque le blé est detruit.*"—Traité sur la Culture des Grains, tome premier, p. 268.

It would be important to know if the crop of wheat, when it does succeed, is ever affected by the rust, in a soil so much impregnated with saline particles.

was then however ascertained, that salt, thus applied, dissolved the coarse heathy substances to be found in such, and converted them into manure.

The effect of salt, applied in the same way *to peat*, in alternate strata, is a most important subject of experiment, which, if successful, would greatly promote the improvement of waste lands. It would probably act more rapidly on peat than on heath, and would thence furnish an immediate manure for a crop of turnips, so well calculated for bringing such soils into a state of fertility.

3. *It is an effectual Remedy against Smut.*—It is well known that seed wheat, if immersed in water, so impregnated with saline particles, that an egg will float in it, and frequently stirred, so that all the unsound grains will rise to the top, which are then skimmed off, will be exempted from smut, provided, after the wheat is separated from the pickle, it is spread upon the floor, and a sufficient quantity of new slacked lime, to dry the whole, is sifted upon it*.

4. *It preserves the Seed when sown, from Vermin.*—In some parts of Scotland, where the oat crops were frequently destroyed by grubs, &c. it has long been a practice, to mix salt with the seed, in the proportion of one to thirty-two, but sometimes one in sixteen. Every means has been taken to ascertain the utility of the practice, and with uniform success. Salt destroys vermin in the ground, by making them void the contents of their bodies, such evacuations being too powerful for them to withstand. It has this additional advantage, that the vermin thus become food for those very plants, which otherwise they would have destroyed†.

5. *It promotes the Vegetation of Oily Seeds.*—This was first discovered in America, in the culture of flax, and it has since been ascertained in this country, by the experiments of Mr. Lee, of Old Ford, near Bow, in Middlesex. The quantity of salt should be the same as that of the seed sown, namely, about three bushels per English acre. It is strewed on the surface after the seed has been sown. It improves greatly the quantity and quality of the flax, and in particular the quantity of the seed from the new crop. Though the experiments have hitherto been confined to flax, it would probably answer equally well with other seeds of an oily quality. It is supposed, indeed, that salt is most useful, when it is mixed with substances containing oil, the union of the two, being converted into a species of saponaceous matter, which is favourable to vegetation‡.

* East Lothian Report, p. 111.

† Lord Dundonald on the Connection of Agriculture with Chemistry, p. 138.

‡ Equal quantities of salt, and of turnip seed, were tried on a small plot of a garden, by the Author of this paper; and the produce was more abundant, than from the same quantity of turnip seed, sown without salt. The efficacy of salt, as a destroyer of the turnip fly, or beetle, ought to be ascertained.

6. *It increases the Produce of the Pasture Land and Meadows.*—It has been proved by experiment, in Cheshire, that after draining sour rushy land, if salt be spread upon the surface, in the month of October, its effects on the crop of next year, will be in the highest degree satisfactory. In one spot, where eight bushels were spread, a most flourishing crop of rich grass appeared in the month of May, but a still stronger crop in the month of July, where sixteen bushels had been applied*.

It is stated, on most respectable authority, that salt, sown thinly by the hand, will destroy the moss with which meadows, and pasture lands, are so apt to be infested†.

In the Netherlands, Dutch turf ashes, which are strongly impregnated with saline particles, are applied to the second, as well as to the first crop of clover, with great success; and Mr. Hollinshead strongly recommends, sowing six bushels per acre, on meadows, after the hay is got in, particularly in dry and hot summers, and upon limestone and sandy soils. The moisture which the salt attracts and retains, powerfully assists vegetation, and produces a crop greatly superior in quality to that obtained by the application of dung‡.

For meadows, it is found to be an advantageous practice, to mix sixteen bushels of salt, with twenty loads of earth, per acre, turning the heap over two or three times, that the substances in it may be thoroughly incorporated, and spreading it on the surface, either in summer or spring§.

7. *It improves the Quality of Hay.*—The practice of salting hay, at the time of stacking it, has been practised in Derbyshire‖, and in the North Riding of Yorkshire¶. The salt, particularly when applied to the second crop of clover, or when the crop has received much rain, checks the fermentation, and prevents moulding. If straw be mixed with hay, the heating of the stack is still further prevented, by the straw imbibing the moisture. Cattle will eat, not only such salted hay, but even the straw mixed with it, more eagerly, than better hay not salted, and will thrive better upon it.

Lord Somerville was of opinion, that salt could not be conveyed into an animal, in a more effectual manner, than by sprinkling it through a sieve, at the rate of twenty-five pounds weight of salt, to a ton of hay, when in the act of putting it together, for every particle is imbibed in the fermentation, without a possibility of waste. This salted hay is of great use to sheep, when put on turnips early in the season, for the tops being then rank and strong,

* Cheshire Report, p. 236.

† Sir Thomas Bernard's Treatise, p. 103. See Col. Scobell's Evidence, ditto, p. 270, note, as to its efficacy in removing moss on old leys.

‡ Hollinshead on Salt as a Manure, p. 26.

§ Hollinshead on Salt as a Manure, p. 25.

‖ Derbyshire Report, vol. ii. p. 182.

¶ North Riding Report, p. 177.

many of the sheep die suddenly from pent-up wind, occasioned by excess of fermentation in the stomach. Salt, or salted hay, is then devoured by them with greediness, which denotes their salutary effect. By the use of salted hay, Lord Somerville did not lose one sheep on turnips in the autumn 1801, though the season was rainy and unfavourable*.

Doctor Paris, likewise contends strongly for improving bad hay, by salt, applying it in the proportion of about one cwt. of foul fishery salt to three tons of hay. But of pure salt, a third of that quantity may be sufficient;—It should be sprinkled between the layers;—It prevents mildew, and renders the hay more grateful, and more beneficial to cattle†.

8. *It renders coarse Food more nourishing, and moist Food less injurious to Cattle and Horses.*—The Ancients were accustomed to prepare their straw for feeding stock, by keeping it for a considerable time, *sprinkled with brine;*—it was then dried, rolled up in bundles, and given to oxen instead of hay‡.

Mr. Curwen finds, that if salt be given to cows, with steamed chaff, and other inferior food, it makes them eat it up completely; and that, in a certain degree, it corrects the taste of milk when cows are fed on turnips, and increases the quantity they produce. In Cheshire, they give their cows a little salt when they are falling off in their milk§.

In Flanders, it has been found, that a small quantity of pounded salt, is very beneficial for horses, when new oats are given to them, if the oats are at all moist; and there can be no doubt, that moist food in general, might be rendered less injurious, by the same means; for instance, when raw potatoes are first given to horses.

Mr. Curwen is convinced by experience, that chaff and straw, might be rendered available to a much greater extent than at present, by the use of salt.

9. *It preserves Stock from Disease, and improves their Condition.*—In several countries, as in America, the East Indies, Flanders, Sweden, and Spain, it has been found that salt given to domestic animals, is advantageous to them in various respects. It may be proper, however, to consider the best mode of applying it to the different sorts of stock, under distinct heads.

Horses.—Mr. Birkbeck, in his notes on a journey in America, recently published, mentions, that the horses he saw in the interior of that country, were of an excellent description, *and are in high condition, even when travelling at the rate of forty-five miles per day on long journeys.* They are fed well, getting from four to five gallons of oats per day, besides hay, *with a good handful of salt about twice a week.*

* Sir Thomas Bernard's Tract on the Salt Duties, p. 262.

† Ditto, p. 276.

‡ Dickson's Husbandry of the Ancients, vol. ii. p. 409.

§ Sir Thomas Bernard's Tract, p. 96. This makes them drink more abundantly, which increases the quantity of their milk.

It appears from an experiment tried at Mr. Alderman Farley's salt-works at Droitwich, that salt is of great use to horses. The quantity given was about four ounces, three days in the week, alternately mixed with chaff. The whole four ounces, should not be given at once, but at several times in the day, about a tablespoonful each time. It makes the animals eat their food, and do their work better.*

Mr. Curwen gives his horses employed at the farm, the colliery, &c. at the rate of four ounces per day, with their steamed potatoes, twice a day. It makes them clean out their cribs, and is a great benefit to their health and condition.

Salt given to horses, cures *the botts;* and it is said, might be given with great advantage to race horses, and would prevent the necessity of applying those severe purges, to which they are at present subjected.

Cattle.—The uses of salt to cattle are various. Besides increasing the quantity, and improving the quality of their milk, as already stated, it prevents their *hoving*, when fed on clover, or on turnips; the tops of which have the same effects as clover, both on cattle and sheep, when eaten in any quantity.

Mr. Curwen's experiments on this head, are most important. From the 19th of November 1817, to the 3rd of February 1818, he gave salt to his cattle in the following proportions:

Sort.	*Number.*	*Quantity per Day, in Ounces.*
Cows and breeding heifers, ...	40	4
Young and fat cattle, ...	43	3
Working oxen, ...	18	4
Heifers and young oxen, ...	21	2
Young calves, ...	20	1
	142	

The cattle are said to have been in the highest state of health ever since the use of salt was commenced; no obstructions, or inflamations as formerly, and not a single animal out of order.

In some parts of America, they give salt to their cows, at the rate of about two bushels per annum.

In the East Indies they give salt to their bullocks, in general daily, to the amount of two or three ounces, mixed with their feed of pulse; a due proportion of salt they consider to be essential for their health, and almost as necessary as food.

Sheep.—The advantages of salt to sheep are very great. It improves their wool considerably, as is experienced, both in Spain, and in the Shetland Islands, where the pastures are so much impregnated with sea spray. It likewise prevents the rot, and destroys the different sorts of worms which are found in the bodies of

* Sir Thomas Bernard's Tract, p. 264.

sheep, in particular, liver worms, (*fascio hæpaticæ**). It is said to protect them likewise from the scab.

In Spain, they give 128lb. of salt to 1000 sheep in five months; but, in a wetter climate, like that of Great Britain, Lord Somerville thought, that a ton of salt, for every 1000 sheep, would be requisite. It should be given them in the morning, to counteract the bad effects of the dew. In dry weather, a small handful may be put on a flat stone, or slate, and 10 or 15 of these slates or stones set a few yards apart, are enough for 100 sheep. If the sheep are brought to the place where the salt is put, they will lick it up quickly, if they find a craving for it; but if they do not want it, the salt may be taken up, and reserved for future use. This may be done twice a week, but in particular cases it may be offered thrice†.

Mr. Curwen finds, that salt prevents what is called the sickness in the northern parts of England, or the *braxy* in Scotland, by which so many thousand young sheep are annually lost; a discovery of the greatest importance in those parts of the kingdom.

Hogs.—The use of salt for pigs, has, latterly, been much practised in Ireland, and is found, not only to keep them sound, and in good health, but to expedite their feeding. The salt should be mixed with their food, (potatoes, &c.) at the rate of a large table spoonful in the twenty-four hours, or even more, should they eat it greedily, and that it does not act too much as a medicine. Some of the fattest pigs ever reared in Ireland, were fed in this manner, and nearly in half the time it usually takes to fatten them, when no salt is used‡.

Poultry.—Salt also, may advantageously be given to poultry, and may prevent some of those disorders to which they are liable. The avidity with which pigeons consume salt, is well known.

On the general Uses of Salt to Stock.—This article is found serviceable, in restoring the tone of the stomach, when impaired by any excess, either of food, or of labour.—It improves the quality of their dung, and renders the sprinkling of it with salt unnecessary.—It renders stock tamer. Mr. Curwen finds that the sheep gather round the shepherd, and will hardly suffer the salt to be deposited on the stones. It overcomes all their natural fear and timidity of disposition: and as to other cattle, it brings the wildest of them to feed out of the hand. In America, milch cows are so fond of salt, after being a little accustomed to it, that if tempted to wander in the woods, they are sure to return, in order to procure their usual allowance;—but above all, it preserves their health. Mr. Mosselman, an intelligent farmer in the Netherlands, who keeps about 100 milch cows, oxen and calves, 23 working

* Baron Sculltz's Observations on Sheep. Communications to the Board of Agriculture, vol. i. p. 318.

† Sir Thomas Bernard's Tract, p. 261.

‡ Communication from Edward Burroughs, Esq.

horses, and 250 sheep, has used salt for five years, *during which time his whole stock have been perfectly free from disorders.*

On the Modes of giving Salt to Stock.—Some give it in a powdered state on slates, stones, or coarse cloths. Others put large lumps of rock-salt, in the cribs or mangers of their stables and cow-houses, or hang it up so as to be accessible to cattle or sheep, who obtain, by licking, what they require. In Sweden, they imagine that the good effects of salt may be greatly promoted, by what are called licklings *(slekor)*. They consist of salt, pulverized wormwood, and juniper-berries, and are given, either in a coarse powder, or made with tar into a thick broth, or electuary, put into a hollow fir-trough, placed in the middle of the sheep-house, over which branches of fir are nailed across, to prevent the sheep from soiling themselves with the broth. Others mix brimstone with this pottage, and make balls of it, which may be particularly suitable for such sheep as are subject to eruptions. Some persons also, mix with it tansy *(tanacetum vulgare)*, bay-berries, and garlick, as being good for the worms and the dropsy.

10. *It has a tendency to prevent Rust or Blight in Wheat.*—In the course of a most extensive enquiry into the causes of the rust, or blight in wheat, and the means of its prevention; it appeared, that Mr. Sickler, a farmer in Cornwall, was accustomed to manure his turnip land with the refuse salt from the pilchard fishery; and that any ground thus treated, *was never liable to the rust or blight*, though it infested all the neighbourhood*.

This important circumstance is confirmed in a recent communication (dated 15th May 1818) to the author, from the Reverend Robert Hoblyn, whose wheaten tillage, on a farm in Cornwall, was increased from 20 to 40 and 50 acres per annum. He used one ton of old salt, with one ton of fresh fish, mixed with earth, and from 20 to 30 ton of sea sand, and his crops, he states, were always good, "*and never infested with rust.*"

It is probable that the salt, is the only article in this compost, that could be of material service in preventing the rust, by its checking putrefaction, the result of too frequent a repetition of corrupted manures; and if *the fact* were ascertained by decisive experiments, a still farther reduction of the duties on salt might be confidently looked for, to secure our crops of wheat from the greatest of all its scourges.

CONCLUSION.

There is every reason to hope, from this enumeration, that important benefits to agriculture, will result, from reduction of the duties on salt. But the anxious endeavours of Parliament, to promote the interests of the farmer, will be in vain, unless he resolves to avail himself of the boon that has been thus conferred upon him. For that purpose, his attention to the various particulars above stated, is earnestly requested.

* Husbandry of Scotland, vol. ii. App. p. 150, note.

No. X.—*Account of Mr. Hunter of Tynefield's System of Farming.*

THE system of farming adopted in the more improved districts of Scotland, being much celebrated, it may be proper to give the following account of the plan pursued by Mr. Hunter of Tynefield, near Dunbar, who is justly accounted one of the most intelligent farmers in East Lothian. It goes upon the principle, of converting nearly all the straw of a farm into dung.

Mr. Hunter's farm consists of 350 Scotch, or 437 English acres. The horses kept for labour are sixteen, or about one horse to 27 acres. The other stock varies according to the quantity of green food produced in the course of the season. It is only necessary to observe, that about ten sheep, weighing from twelve to fourteen pound per quarter, require from thirty to thirty-two tons of turnips (rather more than the average produce of an English acre), to fatten them for market *. Mr. Hunter also keeps some cattle for winter *soiling* † (if that expression can be made use of), which are bought in October and November, and sold in March. The sheep are fattened sometimes sooner, but the above weight of turnip will keep them till that time. The cattle are sold as soon as fattened, if the market offers, and are sooner or later ready, in proportion to the condition they might be in when put up to feed ‡.

Mr. Hunter raises from four to five acres of turnips, for one of ruta baga: the latter, however, requires one-third more manure, to produce a full crop.

The crops Mr. Hunter raises of turnips and of ruta baga, are as follows:

1. *Turnips.*

		Tons per Scotch Acre.	*Tons per English Acre.*
Greatest crops,	turnips 38 tons, tops 6 tons,	44	35
Smallest crops,	- - -	32	25
	Average about	38	30

* At this rate, an acre of turnips fattens from 450 to 500 lbs. of mutton, and nearly as much of beef, which is in the ratio of from 16 to 17 lb. of meat, for every ton of turnips.

† Soiling is commonly understood to mean, giving *succulent herbage* to live stock; but if it properly means *making dung*, it may also be applied to the giving *of roots*, for the purpose of feeding animals, *and providing manure.*

‡ It is calculated, that an acre of good turnips, would feed two and a half cattle of 30 stone Amsterdam, each, 17½ oz. to the pound, and 16 lbs. to the stone; but say, that only two cattle are fed on the produce of an acre of turnips; in that case, it is contended, that 440 lbs. Amsterdam weight, or more of beef than mutton, would be produced, from equal weights of turnips, provided that the turnips be consumed *at the stall by the cattle.*

2. *Ruta Baga.*

		Tons per Scotch Acre.	*Tons per English Acre.*
Greatest crops,	- - -	32	26
Smallest crops,	- - -	23	14
	Average about	27½	20

Mr. Hunter was accustomed to make the intervals of the rows, from twenty-seven to thirty inches. He found, at that time, the crops to average about three or four ton less per acre than he now does, when he makes the intervals from twenty-four to twenty-six inches*.

Mr. Hunter begins to sow winter wheat after turnips, whenever the weather will permit in January, and continues sowing, when the weather is dry, till about the twelfth of March. He afterwards sows the whole of his turnip break or shift, with summer wheat, of that sort recommended by Sir Joseph Banks. He had it from Lincolnshire several years ago; and has sown it at all times, during the spring months, but he has now ascertained, that the proper time of sowing it, in the climate of his neighbourhood, is the two last weeks of April.

The weight of hay, from clover and rye-grass, may average 150 stones of twenty-two pound each, per English acre. But this is the weight in spring. If weighed *from the field,* it would weigh a good deal more, though produced on a soil, not much calculated for a crop of hay, namely, a light soil, incumbent on gravel. Where the soil is of a better quality, 200 stones have been produced.

Mr. Hunter sows wheat after clover, about the middle of January, if the season will allow, if not, as soon after as possible. He ploughs his clover stubble early in December, so that the snails, or other vermin, bred among the clover, may be turned up and destroyed. Formerly, he used to plough and sow in November, but these vermin, not being then in a torpid state, crept into the ground again, and coming out in spring, thinned the wheat materially. Ploughing in December, and sowing in January, or February, has answered his purpose of destroying them effectually.

The produce of wheat after clover, is eight bolls per Scotch acre, or twenty-seven bushels per English acre; that of oats is ten and a half bolls per Scotch acre, or fifty-two bushels per English acre.

Mr. Hunter pastures very little with cattle or horses; indeed he proposes giving it up altogether, unless in barren soils, where the plough cannot be introduced; and he means to convert any clover

* This can only be attempted, however, where the land is in very good condition. Intervals of from twenty-eight to thirty inches are to be preferred, with land not in good condition, or where abundance of manure cannot be given.

that may be left from soiling, into hay, for his horses in winter and spring.—By giving fourteen pound of oats per day to a horse, with ruta baga, he has been able to save a third part of the allowanc of oats given to his horses, when no hay or ruta baga were used. On the above allowance, Mr. Hunter's horses are worked nine hours every day, when the weather will permit.

The manure hitherto given to turnips by Mr. Hunter, has not been so great as he wished; but as the quantity on the farm increases, a greater quantity has been applied. Mr. Hunter is quite clear, that the land can never be over-manured for turnips.

The depth of the first furrow, for the turnip fallow, is from nine to twelve inches, where there is a depth of soil; the after ploughing, about six or eight; after the turnips have been eaten off, the ploughing ought only to be about three inches for wheat, to prevent the seeds of annual weeds being brought up; after the clover, four or five inches is a proper depth for oats or wheat.

The stock kept upon turnips or clover, have the refusal of water at all times when soiling; *cattle in summer must have it.*

When turnips are taken up to the extent of a half, four rows are left, and four taken up alternately; if a third part is to be taken, six are left, and three taken alternately. As soon as the turnips or ruta baga begin to run or shoot in spring, they are taken off the field, when the tops and roots are cut off; they are then piled up in some place, sheltered from the sun or too much air; and being covered with a little straw, and kept moist, they may be preserved as long as they can be wanted; the ruta baga will be perfectly good to the first of June.

Mr. Hunter sows no more barley, than is required for paying his farm-servants their wages in kind, which are partly paid in barley; having from experience found, that wheat after clover, sown with barley, often fails on his soil, which he was not aware of, when he first began farming*.

When circumstances permit, Mr. Hunter limes once in fourteen years, at the rate of 60 barley bolls per English acre. Lime ought to be applied to all lands, under a rotation of four crops, where white and green crops are sown alternately.

The weight of potatoes per English acre, under good culture, and a proper soil, is from eight to ten ton. Mr. Hunter was accustomed, before he found that horses throve on ruta baga, to give them potatoes occasionally, though they did not thrive so well on them, even when steamed, as he could have wished. He has now laid potatoes entirely aside, unless those raised for swine, finding ruta baga greatly superior for horses.

It is proper to explain the system adopted by Mr. Hunter, for cultivating light land. The basis of that system is, 1. Alternate

* It is an old Scotch maxim, "He that saws wheat after bear, had need of meikle gear;" or, he should be a rich man, who sows wheat after barley. But it is probable, that on rich land, this rule need not be enforced.

white and green crops; 2. Converting nearly the whole of the straw produced on his farm into dung; 3. Ploughing deep at particular periods; and 4. Soiling both summer and winter.

1. The rotation he follows is, 1. Turnips; 2. Wheat; 3. Clover; 4. Wheat or oats; half of the clover being pastured with sheep, whilst the other half is used in soiling work-horses. The clover stubble is broken up for wheat or oats, generally in the proportion of two-thirds for wheat. Under the above rotation, the crops, on an average, have increased in produce considerably.

2. Mr. Hunter's object is, *invariably to convert almost the whole of his straw into manure*; for by giving plenty of green food, very little of the straw is eaten by cattle or sheep, either in summer or winter. Horses, indeed, require at all times some straw, along with ruta baga, more especially in November, and the first months of winter, when ruta baga has not reached its full growth, a few of these roots are given, and a greater proportion of straw or hay is wanted. If any considerable quantity of clover can be converted into hay, the straw will be perfectly unnecessary, unless for litter.

3. Soon after Mr. Hunter began this system, he thought that the turnip, and other crops, were rather falling off, but fortunately he discovered a remedy, which was, to plough very deep the first furrow given to the turnip fallow. This he did, whatever was the depth of the soil, sometimes using three or four horses in the plough. Since he adopted that practice, all the crops are more certain, seldom if ever failing, unless owing to the inclemency of the season, and never from being often repeated.

4. Mr. Hunter makes it a rule, to soil both summer and winter, preserving as much straw from the winter soiling-fold, as will be sufficient for littering horses, young cattle, and swine, during the summer; giving always plenty of green food, chiefly clover. Soiling in an open fold, with cut clover, in summer, does not require so much straw, as winter soiling with turnip. He has not ascertained the proportions exactly, but thinks, that one-half will suffice in summer, than what is required in winter.

The stock are fed in the following manner: They have always abundance of green food or roots. One-half, or sometimes one-third of all the turnips produced upon the farm, are carted to the fold or straw-yard, to sheep, young cattle, and swine. The swine have at all times clover in summer, and turnips or ruta baga in winter, together with potatoes, for those meant to be fattened. The working horses have also half a bushel each of ruta baga during winter and spring, so that all the stock are soiled, the milch cows excepted, who get the whole chaff, and other refuse from the threshing-mill, and the sheep, when they are pastured on clover, to consolidate the ground. Within these few last years, instead of feeding his pigs with raw or boiled potatoes, Mr. Hunter gives them one-half Swedish turnip. He has a boiler filled with the turnips, sliced, to which a board is fitted, to prevent the steam from going

off; a tin pipe is let into it of sufficient length to reach the steamer, into which the potatoes are put; by which means, both potatoes and turnips are done at once. They are both then put into a tub, and mixed together with the water in which the turnips were boiled, forming a mess, which far exceeds giving either by itself. The animals eat it greedily, and thrive apace. The water in which the Swedish turnips are boiled is found to be extremely nuorishing.

Mr. Hunter is decidedly of opinion, that any soil adapted for turnips, and which will produce seven bolls of wheat per Scotch acre *(or say 24 bushels per English acre)*, or nine bolls of oats per Scotch *(or 44 bushels per English acre)*, cannot be put under a more profitable system, or rendered more productive, than in the way he has adopted. By the frequent ploughings given to the turnip break or shift, the land is made perfectly clean. Turnip is the only crop, for which, according to Mr. Hunter's experience, land cannot be over-ploughed. So much ploughing for turnip, would, in his opinion, be hurtful to the after crops, were it not, that one-half or more of his turnips, are eaten on the ground with sheep, which brings it to a proper consistence for the succeeding crops of wheat, &c. Where land has been over-cropped, or it may be rather said, *over-ploughed*, farmers will find two or three years' pasture necessary, to consolidate the soil; but he is so partial to soiling, that he thinks two years' soiling, preferable to two years' pasturing, even though the second year's crop should be greatly deficient; as he is certain, from his whole practice, of constantly having oats after cut clover, as well as the other crops, fully equal to those after pasture, and that the produce will be equally great, during the whole after crops in the rotation.

This idea of soiling two years in succession, instead of pasturing the second year, is justified by the opinion, that one acre soiled, is equal to two pastured *.

No. XI.—*A Communication on the Produce, Expence, and Surplus of Farms; including the Comparative Value of several Rotations of Crops. By John Middleton, Esq.*

THE produce, expence, and surplus of farms, depend on so many circumstances of an uncertain nature, that the following statements ought to be considered only as approximations towards truth. The intelligence of farmers, and their constitutional energies, are as different as their persons; the effects of these are not subjects of estimate, and yet, they have important consequences on the produce, expence, and profits of farms. Neither must it be expected of these statements, to apply accurately to the case of any particular person; but rather as applicable to the general run of husbandmen.

* This is a most excellent paper; few whole volumes contain so much valuable information. For the south of England, I should try winter tares before turnips.—*J. M.*

And even to do this, will require a rotation of crops to be assumed; for it is certain, that as much depends on the rotation of crops as on any other part of the farmer's profession.

It is intended to submit to the consideration of the reader, four or five of the rotations now in use; and in that manner, render it obvious, that one or other of them may be applied to the case of very many cultivators of arable land.

These estimates are purposely selected from many others, as being suitable to to the cases of such farms as are 20 or more miles from London, or any such very valuable market; but within five or six miles of a tolerably good market town.

A specification of the labour to be performed, and the expence of it; the quantity and value of the produce; as well as that of the surplus of each crop, may be looked for under the several heads of fallow, tares, turnips, barley, clover, and wheat. To avoid repetition, the amount only in money of each crop, will be inserted in this place.

Table A.

	Value of Produce.	*Expence of it.*	*Surplus.*
	£	£	£
1. Fallow, costs about 7*l.*, but in this place only 4*l.* will be inserted, as the other 3*l.* are included in the barley, or other succeeding corn crops, ...	0	4	0
2. Tares, ...	5	3	2
3. Turnips, ...	5	3	2
4. Barley, ...	8	3	5
5. Clover, ...	7	3	4
6. Wheat,.....	12	3	9

Near any great town, where hay, straw, and green crops are saleable, these several sums would be very much increased.

The first estimate is for a rotation of fallow, barley, clover, and wheat in four years; or, it would do equally well for a rotation of fallow, wheat, clover, and oats. The account of this rotation, collected from Table A, shews the produce of four years to be 27*l.* which is annually 6*l.* 15*s.* The expences are 13*l.*, or annually 3*l.* 5*s.* which deducted from 6*l.* 15*s.*, leaves 3*l.* 10*s.* as the annual surplus per acre. The last sum is applicable to the following charges:

	£	s.	d.
One third part thereof to the subsistence of the farmer's family, in the character of profit and interest, per acre, ...	1	3	4
Rent, another third of the surplus, ...	1	3	4
Tithes, taxes, and assessments of all sorts payable by the farmers, amount to about 53 per cent. on			
Carried forward,	£2	6	8

	£	s.	d.
Brought over,	2	6	8
their rents. And the tenant's repairs, thefts of cattle, crops, furniture, and implements, deterioration of all sorts, bad debts, and other losses of several kinds, as well as insurance from loss by fire; together with the taxes thereon, are supposed to be worth 47 per cent. on the rent.			
In this manner, it is endeavoured to be shown, that tithe, taxes, assessments, repairs, losses, insurance, and other charges just enumerated, are equivalent to the rent, ...	1	3	4
The whole surplus per acre	£3	10	0

The farmer's profits of 1*l.* 3*s.* 4*d.* per acre, on a farm, suppose of 200 acres, will amount annually to 233*l.* 4*s.*; and as the fallow system admits few cattle, 7*l.* per acre, or 1400*l.* would be a sufficient capital, and on that sum the profits is 16*l.* 13*s.* per cent.

The second Estimate, is for a rotation of either tares or turnips, barley, clover, and wheat in four years.

This rotation is rather deservedly a favourite with many agriculturists; and the comparative value of it, collected from Table A, shews the produce of the four years to be 32*l.*, or annually 8*l.* The expences are 3*l.*, which deducted from 8*l.*, leaves 5*l.* as the average annual surplus per acre. The last sum is a fund for the following charges:

	£	s.	d.
Tithes, taxes, assessments, repairs, losses, insurance, and such charges as are more fully specified in the first estimate, one-third of 5*l.* is per acre	1	13	4
Profits and interest, ...	1	13	4
Rent, ...	1	13	4
	£5	0	0

The profits of 1*l.* 13*s.* 4*d.* per acre, on a farm, suppose of 200 acres, would amount annually to 333*l.* 6*s.* 8*d.* and as the farm in this rotation would support more live stock than in the former case, a capital of 1600*l.* may be necessary, and that would yield a profit of 20*l.* 16*s.* per cent.

The third Estimate, is for a rotation of tares and turnips in succession the first year; second year barley; third year clover; and the fourth year wheat; or the second year may be wheat; the third clover; and the fourth oats. This rotation is of the first rate excellence: and it may be collected from Table A, that the produce of the five crops in four succeeding years, are worth 37*l.*, or they average annually 9*l.* 5*s.* The expences are 15*l.*, or, annually,

3*l.* 15*s.*, which deducted from 9*l.* 5*s.*, leaves 5*l.* 10*s.* as the surplus, applicable to the following charges :

	£	s.	d.
Tithes, taxes, assessments, repairs, losses, insurance, and other charges specified in the first estimate, one-third of the 5*l.* 10*s.* or	1	16	8
Profits and interest, *per annum*	1	16	8
Rent, *per annum*	1	16	8
	£5	10	0

The profits of 1*l.* 16*s.* 8*d.* per annum, on a farm of, suppose 200 acres, would amount to 366*l.* 13*s.* 4*d.*; and as the farm would, in this case, support considerably more live stock, a capital of 1800*l.* may be necessary: and even that would yield a profit of 20*l.* 7*s.* 6*d.* per cent.

The fourth Estimate.—Suppose a farmer, at many miles distance from London, or any very good market, and where he is confined to consume all his crops upon the farm, should adopt the rotation of tares, turnips, and wheat, and obtain these three crops every two years, what would be the result? It may be collected from Table A, that the produce of these three crops are 22*l.*, or, annually, 11*l.* per acre. The expences of them are 9*l.*, or, annually, 4*l.* 10*s.*, which deducted from 11*l.*, leaves 6*l.* 10*s.* as the average annual surplus, applicable to the following charges :

	£	s.	d.
One-third thereof for tithes, taxes, &c. as in the former cases, would be, per acre, ...	2	3	4
One-third thereof for profit and interest, ...	2	3	4
One-third thereof for rent, ...	2	3	4
Together	£6	10	0

The profits of 2*l.* 3*s.* 4*d.* per acre on a farm of, suppose 200 acres, would amount to 433*l.* 6*s.* 8*d.*; and as the farm would, in this instance, require and support much more live stock than in the former cases, a capital of 10*l.* per acre, or 2000*l.* may be necessary: and even that would yield a profit of 21*l.* 13*s.* 4*d.* per cent.

The relative merits of the foregoing four or five rotations of crops, are rendered more obvious by the following summary observations :—The crops are supposed to be equally productive in each of the rotations; and the money is in all cases extracted from Table A. This was done in order to shew the highest degree of fairness in making out the comparative estimates. It shall now be shewn, that

No. I. A farm of 200 acres, in a rotation of naked fallow, and 3 crops in 4 years, may yield annually, in profits and rent, 233*l.* each, or £466

No. II. The same farm, with one crop of either winter tares, or turnips, and the like 3 other crops, in 4 years, would yield annually, in profits and rent, 333*l.* each, or	£66
No. III. The same farm, with the two crops of winter tares and turnips in succession, and the like 3 other crops, in 4 years, would yield annually, in profits and rent, 366*l.* each, or	732
No. IV. The same farm, cropped with winter tares, turnips, and wheat, every two years, would yield annually, in profits and rent, 433*l.* each, or.....	866

This statement proves, that even in country places, the most distant from market, the very short rotation of, 1. Tares, and turnips; and, 2. Wheat, is greatly the most profitable to the farmers, and advantageous to the landlords; as well as vastly superior, in the valuable properties of cleansing the soil, and enriching it, to any other rotation which has been compared with it. And much as green crops are superior to the fallow system, in these cases of distance from market, they have a still greater advantage, where their situation is contiguous to a large town*.

No. XII.—*On General Statements of Produce and Expence.*

It being essential for every farmer, to prepare an annual statement of the produce, expences, and profit derived from the land he occupies; as a model for such statements, the following account is given, of a farm in East Lothian, consisting of 553 Scotch, or 691 English acres, as drawn up by that intelligent gentleman-farmer, George Rennie, Esq. of Phantassie.

Before detailing the particulars, it is proper to state, that as the farm contains different soils, a part of it is managed according to the four-course shift, and the remainder according to a six-course shift:

The first part, which consists of about 252 Scotch acres, is managed in the following manner: 1. Fallow;—2. Wheat;—3. Clover and rye-grass, either soiled, or converted into hay;—4. Oats;—5. Beans, drilled and horse-hoed, and tares†;—6. Wheat.

The second part consists of about 248 Scotch acres, and is cropped in the following manner: 1. Turnips;—2. Thirty-one acres winter wheat, sown in spring, and 31 acres of barley;—3. Clover and rye-grass, generally pastured;—4. Oats.

* These observations, however, are best adapted for the southern districts of England, and, in particular, for the neighbourhood of the metropolis.

† Five acres are annually sown with tares, in the field destined for beans.

Besides the above, there are about 53 acres kept in perennial pasture, which is broken up when occasion requires. The above is the general system of management adopted upon this farm-though at particular times, it may be partially departed from, according to seasons and circumstances.

An extensive distillery being carried on upon Mr. Rennie's property, a considerable quantity of dung is thereby furnished. The benefit derived from this source is no doubt of great importance, therefore a charge in the account of expences is made against the farm, for the increased quantity of manure obtained by means of distillery materials.

I. *Table of Produce.*

1st, *On Clay Soils, arranged according to the Six Courses.*

		£	s.	d.
1.	42 Acres fallow.			
2.	42 acres of wheat after fallow, at 10 bolls, is 420 bolls, at 40*s.* per boll, - -	840	0	0
3.	42 acres of clover and rye-grass made into hay, 200 stones per acre, is 8400 stones, at 10*d.*	350	0	0
4.	42 acres of oats, 10 bolls, is 420 bolls, at 25*s.*	525	0	0
5.	42 acres beans, 8 bolls, is 336 bolls, at 24*s.* (including 5 acres tares*), - -	403	4	0
6.	42 acres wheat, 8 bolls per acre, is 336 bolls, at 40*s.*	672	0	0
	252	£2790	4	0

2dly, *On Light Soils, managed according to the Four-course Shift.*

1.	62 acres turnips, at 10*l.* - -	£620	0	0
2.	31 acres winter wheat, sown in spring, at 8 bolls, is 248 bolls, at 40*s.* -	496	0	0
	31 acres barley, at 10 bolls, is 310 bolls, at 30*s.*	465	0	0
3.	62 acres of clover and rye grass pastured, at 7*l.*	434	0	0
4.	62 acres oats, at 10 bolls, is 620 bolls, at 25*s.*	775	0	0
	248	£2790	0	0
	Value of 53 acres kept in perennial pasture, at 4*l.* per acre, - - - -	212	0	0

* Though the tares are soiled, it was thought best to state their value the same as the beans.

Abstract.

Value of produce raised on the clay soils, -	£ 2790	4	0
Ditto of ditto raised on the light soils, -	2790	0	0
Ditto of perennial pasture, - - -	212	0	0
Total value of produce,	£ 5792	4	0
From which deduct the amount of rent and expences, as per the second table, -	5146	16	10
Net profit, -	£ 645	7	2

The net profit appears to be 1*l.* 4*s.* 2½*d.* per Scotch acre, (or 19*s.* 4½*d.* per English acre), which is a trifle more than eleven per cent. upon the capital stock, (besides the legal interest), supposing the amount of that stock to be 6000*l.*

II. *Table of Rent and Expences.*

Seed for Six-course Shift.

1. Wheat for 42 Scotch acres, at 3 firlots; 31½ bolls, at 40*s.* - - -	£ 63	0	0
2. Clover and rye-grass for 42 acres, at 20*s.* -	42	0	0
3. Oats for 42 acres, at 14 pecks per acre, is 36¾ bolls, at 25*s.* - - -	45	18	9
4. Beans for 42 acres, at 19 pecks per acre, is 49 bolls 14 pecks, at 24*s.*, including the price of seed for five acres of tares*, - -	59	17	0
5. Wheat for 42 acres, at one boll, is 42 bolls, at 40*s.*	84	0	0

Seed for Four-course Shift.

1. For turnips, 62 acres, at 2 lb. - -	6	4	0
2. Wheat, 31 acres, at 1 boll, is 31 bolls, at 40*s.*	62	0	0
2. Barley, 31 acres, at 9 pecks, is 17 bolls 7 pecks, at 30*s.* - - -	26	4	2
3. Clover and rye-grass seed, 62 acres, at 20*s.*	62	0	0
4. Oats, 62 acres, at 14 pecks, is 54¼ bolls, at 25*s.*	67	16	3
Value of seed,	£ 519	0	2

Value of Hay and Corn consumed by Horses.

1. Hay, 2000 Scots stones, at 10*d.* -	£ 83	6	8
2. Corn, 350 bolls, at 25*s.* - -	437	10	0
3. Clover and rye-grass used in soiling 10 acres, at 8*l.* - - - -	80	0	0
4. Tares, 5 acres, at 8*l.* - -	40	0	0
	£ 640	16	8

* The seed tares for an acre, are charged at the same price as beans, it being well known that a much smaller quantity of tares is required for seeding the ground, than of beans.

Expences of Labour.

1. Overseer,	£50	0	0
2. 15 men servants, at 35*l.* per annum,	525	0	0
3. 2 labourers and a boy,	70	0	0
4. Cleaning turnips,	50	0	0
5. Harvest-work, besides what is furnished by servants on the farm,	220	0	0
6. Threshing, cleaning, and marketing,	80	0	0
7. Smith, carpenter, and saddler,	100	0	0
8. Incidents,	30	0	0
	£1125	0	0

General Articles.

1 Rent 553 acres, at 4*l.* per Scotch, or 3*l.* 4*s.* per English acre,	£2212	0	0
2. Assessed taxes, and statute labour,	50	0	0
3. Dung from distillery,	200	0	0
N. B. The original materials furnished by the farm is supposed to be increased in value to the above amount, by being manufactured at the distillery.			
4. Interest on capital stock, say on 6000*l.*	300	0	0
5. Tear and wear of perishable stock,	100	0	0
	£2862	0	0

Abstract of the whole.

	£	s.	d.
Value of seed,	519	0	2
—— of horse corn, &c.	640	16	8
—— of servants' labour,	1125	0	0
General articles, such as rent, &c.	2862	0	0
	£5146	16	10

No. XIII.—*On the Management of an Extensive Property.*

WHATEVER may be the case in regard to small properties, or those of a moderate size, it is evident that a great estate, spread over different counties, and perhaps situated in various parts of the United Kingdom, is the most likely to be advantageously managed, when the proprietor calls in the assistance of two or three intelligent friends, to aid him in conducting so complicated a concern. No individual can be equal to such a task, unless he is in the prime of life, dedicates his whole time to the business, and gives up every other occupation:—whereas, in this country, it is expected, that

great landholders, should direct their attention to public, as well as private matters, being generally Members of either of the two Houses of Parliament.

Wherever an estate is of great extent, indeed, it has in general been found expedient by the proprietor, to nominate two or three commissioners, to assist him in its management. It is necessary that such commissioners, should be men of prudence, possessed of comprehensive minds, and particularly distinguished by their knowledge of agriculture and rural concerns; they ought to make themselves thoroughly acquainted with all the affairs of the estate, by means of proper documents, such as reports on the boundaries;—state of the farms;—nature of the leases, and covenants in them;—number of farmers, cottagers, and live-stock;—the state of culture;—rotations adopted, &c.;—with such plans of improvement, as the alteration in the size of farms, and the boundaries of each, may render practicable.

They ought likewise to have correct reports regarding the titles to the estate;—the political and other privileges to which it is entitled; also, detailed information, in proper documents, regarding the state of the woods, fishings, mines, drainages, roads, bridges, &c.

These reports, properly arranged, and inserted in books, accompanied by sufficient references, would give a view of a great estate, capable of bringing every important particular under the eye of the proprietor, or of his commissioners, *at a single glance*; whilst, at the same time, a curious and interesting account, of a great portion of a country, might thus be preserved, for future information.

In conducting the business of such a property, every legal question, and every demand of a tenant, or of a neighbour; every question about roads, bridges, churches, tithes, stipends, &c. will thus be brought under the consideration of intelligent men, capable of deciding, and judging impartially, on the points that come before them.

Under the superintendence of such commissioners, the affairs of a great property, would be as well conducted, as on the best managed small, or moderate-sized estates; while the duties of the proprietor, would principally be, to carry those exercises of true benevolence into effect, which would consist,—in softening those stricter decisions, which such a commission might conceive itself bound to give;—or in granting those marks of approbation and reward, which, when bestowed by the proprietor himself, are the most likely to produce beneficial consequences.

No. XIV.—*Estimate of the Quantity of Land required to produce the Wheat necessary to supply the Market of London with Flour,—and on the different Sorts of Wheat sold at Mark-Lane, London.*

THE weekly consumption of flour in London, is, on an average, in sacks, ...	15,000
The number of quarters of wheat required to produce that quantity of flour, is	14,000
The total quantity of wheat required, in quarters, per annum, ...	728,000
The total number of acres, at twenty bushels per acre, statute measure, ...	242,666

On the different Sorts of Wheat sold in Mark-Lane.

Weight of the Cape of Good Hope wheat, 64 lb. per bushel.

Average weight of Dantzic wheat, from 56 lb. to 57 lb.

Weight of English wheat, of crop 1817, 59 lb.

But owing to the greater lightness of the skin, or hull of the Dantzic wheat, it produces more flour than the heaviest English.

In Poland, the wheat is covered with snow in the winter season, and when the summer does commence, the weather is regular, which greatly tends to promote and improve the quality of the grain.

No. XV.—*On the Importance of the Distillery to British Agriculture.*

(Extract from Burke's Works, 4to. Edition, Vol. IV. p. 284.—"On the Stoppage of the Distillery.")

"ANOTHER cause, and that not of inconsiderable operation, tended to produce a scarcity in flesh provisions. It is one that, on many accounts, cannot be too much regretted; and the rather, as it was the sole cause of scarcity in that article, which arose from the proceedings of men themselves—I mean the stop put to the distillery.

"The hogs, (and that would be sufficient), which were fed with the waste wash of that produce, did not demand the fourth part of the corn used by farmers in fattening them. The spirit was nearly so much clear gain to the nation. It is an odd way of making flesh cheap, to stop or check the distillery.

"The distillery in itself produces an immense article of trade, almost all over the world: to Africa, to North America, and to

various parts of Europe. It is of great use, next to food itself, to our fisheries, and to our whole navigation. A great part of the distillery was carried on by damaged corn, unfit for bread, and by barley and malt of the lowest quality. These things could not be more unexceptionably employed. The domestic consumption of spirits produced, without complaints, a very great revenue, applicable, if we pleased, in bounties, to the bringing corn from other places, far beyond the value of that consumed in making it, or to the encouragement of its increased production at home.

"As to what is said, in a physical and moral view, against the home consumption of spirits, experience has long since taught me, very little to respect the declamations on that subject. Whether the thunders of the laws, or the thunder of eloquence, "is hurled on *gin*" always, I am thunder proof. The alembick, in my mind, has furnished to the world a far greater benefit and blessings, than if the *opus maximum* had been really found by chemistry, and, like Midas, we could turn every thing into gold.

"Undoubtedly there may be a dangerous abuse in the excess of spirits; and at one time, I am ready to believe the abuse was great. When spirits are cheap, the business of drunkenness is achieved with little time or labour; but that evil I consider to be wholly done away. Observations for the last forty years, and very particularly for the last thirty, have furnished me with ten instances of drunkenness from other causes, for one from this. Ardent spirit is a great medicine often to remove distempers, much more frequently to prevent them, or to chase them away in their beginnings. It is not nutritive in any *great degree.* But if not food, it greatly alleviates the want of it. It invigorates the stomach, for the digestion of poor meagre diet, not easily alliable to the human constitution. Wine, the poor cannot touch. Beer, as applied to many occasions, (as among seamen and fishermen, for instance), will by no means do the business. Let me add, what wits inspired with champaign and claret will turn into ridicule, it is a medicine for the mind. Under the pressure of the cares and sorrows of our mortal condition, men have at all times, and in all countries, called in some physical aid to their moral consolations—wine, beer, opium, brandy, or tobacco.

"I consider, therefore, the stopping of the distillery, economically, commercially, medicinally, and in some degree morally too, as a measure rather well meant, than well considered. It is too precious a sacrifice to prejudice."

Experiments with Sugar Wash.

Mr. Warren, of Knightsbridge, finding that his employers, Messrs. Smith and Harrington, of Brentford, were likely to suffer much from the sudden stoppage of the distillery, in the year 1796, after they had laid in a great store of cattle, which they had intend-

ed to feed with the refuse of their distillery; he resolved to try whether the spent wash of the sugar distillery, with the assistance of hay instead of grains, would not answer. The experiment was tried on a great scale, for he fed that year, on that plan, about 250 bullocks. He kept them for about four months, and the average increased price was about 8*l.* per head. But the hay was then only from 4*l.* to 4*l.* 10*s.* per load, and from 30 to 40 quarters of brewers' grain, were given them per day, and though the distillers only charged 20*s.* for the wash given to each bullock, yet he lost money by the attempt; at the present price of hay, therefore, namely, 6*l.* per load, it is his opinion, that it would be better to throw the wash into the Thames, than to attempt to fatten cattle with hay, and the spent wash of the sugar distillery, even with the assistance of brewers' grains.

On the Value of the Refuse of the Distillery.

Messrs. Smith and Harrington, of Brentford, on the refuse of 25,750 quarters of barley, fattened 810 oxen, which averaged 110 stone each. They were in tolerable condition when taken in to fatten. In 20 weeks, they received an addition of flesh, at the rate of 35 stone each ox, but as they ate some hay, 5 stone are deducted on that account, leaving 30 stone per head, as the produce of the distillery. 810 beasts, at 30 stone, give 24,300 stone of beef, from 25,750 quarters of barley, which, at a rough estimate, might be called a stone of beef from a quarter of corn.

If the total consumption of barley in the distilleries of England, be taken at 300,000 quarters, it implies a production of beef to the amount of 283,000 stone, or 2,264,000 pounds weight,—which would be no inconsiderable counterbalance for the loss of the 300,000 quarters of barley, and would furnish much more acceptable food to the people of this country.

A Statement of the Taxes paid on Barley, per Quarter, when used in the Distillery.

	Per Quarter. £	s.	d.
1. Malt, duty at 10*l.* 8*s.* on six quarters of malt, and 8 of raw grain, ...	0	14	10¼
2. Spirits, duty at 7*s.* 3*d.* per gallon, for 18 gallons per quarter, the proportion of 252 gallons for 14 quarters, ...	6	10	6
Total per quarter, ...	£7	5	4¼

A State of the Tax, per Acre, on Land growing Barley consumed in the Distillery.

	Per Acre. £	s.	d.
For 4 quarters (a moderate crop), the income derived by the Treasury, is	29	1	5
For 5 quarters, ...	36	6	$9\frac{1}{4}$
For 6 quarters, ...	43	12	$1\frac{1}{2}$
For 7 quarters (which Mr. Eyles, of Hants, calls an average crop in that county, see Report, p. 138),	50	17	$5\frac{3}{4}$

This is besides the land-tax, the property tax, the tax on horses employed in husbandry, and various other indirect sources of revenue.

The Result.—A quarter of barley, after being used in the distillery, produces near a stone of beef; 300,000 quarters, would therefore produce 283,000 stone, or 2,264,000 pounds of beef. Every quarter of barley pays of duty 7*l.* 5*s.* $4\frac{1}{4}$*d.*; a crop of 4 quarters would produce 29*l.* 1*s.* 5*d.*; and of 7 quarters, no less a sum than 50*l.* 17*s.* $5\frac{3}{4}$*d.* per acre, of revenue to the public.

No. XVI.—*On Drilling in Scotland.—By a Scotch Farmer.*

THE general question is, whether broad-cast sowing, by which all the surface is more or less regularly occupied with plants; or sowing in rows, with intervals between them, of a greater or smaller size, for the admission of atmospheric influence, and for hoeing, be the preferable practice.

In regard to the argument, that drilling is the preferable practice, because the seed is better covered, and deposited at a more equal depth; it is to be observed, that by the use of properly constructed harrows, lighter or heavier, and longer or shorter, according to the nature of the soil, seed will be covered sufficiently; and in regard to the seed being deposited *at a given depth,* some latitude may be allowed in this respect, as the superincumbent soil is not always of the same density or gravity, nor in the same state of pulverization.

Drilling is not applicable to a tough old sward, or to a lay or layer of three years or more, without much preparation, and much previous labour and expence, such as paring and burning, trenching, or repeated ploughings.

Drilling is not applicable to soil incumbered with stones, nor where the land is very steep.

Drilling is not well calculated for strong clays; nor where the wetness of the soil, requires the ridges to be much raised, so as

to describe the segment of a circle; at least this is the opinion of the most intelligent farmers in Scotland, whatever may be effected in the superior climate of England.—To reduce a strong clay soil to the requisite degree of fineness, would require much additional labour,—is impracticable in an unfavourable season,—and while this labour is going forward, or perhaps nearly completed, and the soil ready for the seed, the fall of a few hours' heavy rain, would, by again rendering the surface soil adhesive and lumpy, make all this labour useless.—Add to this, that our seasons in Scotland are too precarious to allow of the slow process of drilling, in the best manner, for wheat, large tracts in October and November, which had been previously cropped with beans. At this season, it is not a matter of choice, *but of necessity,* to put in the wheat, with the least possible delay.

There is every reason therefore to believe, that more wheat will not be obtained by drilling the well-dressed fallows of East-Lothian and Berwickshire, than under the present system of broad-casting; at least, not as much more, as would pay for the additional labour it would require, and the greater risk from the seasons.

Drilling also, is of little or no advantage after turnips, properly dressed, and eaten on the ground by sheep; and the reason is, that broad-casting is cheaper, and not less productive, when, if the soil is not ploughed deeper than before, which on this occasion ought never to be the case, no annual weeds will rise, to render hoeing necessary.—Nor are annual weeds common after a lay or layer that has been pastured for some years, nor after a heavy crop of clover cut for hay. But drilling seems to be advisable in the following cases.

1. When wheat is sown after turnips, *in autumn or winter,* and grass-seeds are to be sown among it in spring. The opportunity given by drilling, to hoe in the spring, even though there be little danger of weeds, is desirable, for the sake of covering the grass-seeds, which do not always succeed well on winter-sown wheat, when harrowed, and even harrowing is sometimes inexpedient.

2. When corn succeeds beans, (if the soil be not too strong a clay, nor too wet), potatoes, turnips carried off, pease, a deficient crop of clover, and generally, whenever the soil is infested either with annual or with root-weeds, drilling may be adopted with idvantage; for though it will not afford an opportunity for destroying the latter, yet the hoeing will keep them down, and lessen the njury the crop would otherwise sustain from them.

3. When dung is applied to a spring sown crop of corn, unless the dung be completely rotted. Such dung is never quite free from seeds.

Lastly, Even where land is so stiff, as to require *occasionally* a summer fallow, drilling might be adopted on the fallow with advantage, when the season will permit, especially when (as is commonly the case) dung is applied, and grass-seeds are to be sown in the spring. If the dung be not well rotted, the reason is the same

in this case, as in the former;—by hoeing in the spring, the seed plants, and some of the roots which the soil may contain, will be got rid of. As to the grass-seeds, that they will thrive better after the soil has been loosened and pulverized by the hoe, is incontrovertible.

The chief advantages of drilling, therefore, consist, in the opportunity it affords, for the destruction of weeds; and for pulverizing the soil, after being battered by the rains of winter, and crusted by the winds of spring.—But these are very great advantages.—Under skilful and assiduous management, they may protract the recurrence of plain fallow, even on pretty strong clays, and they may supersede fallow altogether, on much land, that now undergoes that expensive process, every four or six years.—Besides, there cannot be a doubt, that crops of grain, more especially after potatoes, and often also after pease, would be very greatly improved by being drilled.—Such land is never in so clean a state as it should be—witness the crops after potatoes near Edinburgh.—Street dung, or stable dung, in a fresh state, is commonly used for that crop, and the succeeding crop of corn, unless drilled and hoed, is uniformly annoyed by weeds of different kinds, which the hoe would either destroy or keep in check.

As to the other advantages ascribed to drilling, doubts may be entertained whether corn or culmiferous crops require to be drilled, in order to admit the influence of the atmosphere, so useful to turnips and potatoes, and to beans and pease, which carry their seeds from the bottom of the stalk to its top. The ears of corn, on the other hand, are so placed, as to be always accessible to the air, while they are standing.—The stalks are nourished from the soil, and not like green crops from the atmosphere. Some doubts are likewise entertained, whether crowding their roots together in rows, instead of letting them spread equably through the whole surface-soil, as in the case of broad-casting, is not a disadvantage.

It seems also very doubtful, whether drilled crops are less apt to be lodged than broad-cast; and it is pretty well ascertained, that while the crops are standing, the broad-cast will suffer less from wind; the rows operating upon one another like skutchers.

The great objects to be attained by the row-culture, are, to preserve *the soil clean, and, with a view to grass-seeds, fine.*—That drilling and hoeing will promote these two objects, cannot be doubted, and it should therefore be adopted, wherever it is practicable, without incurring a heavy expence. On all friable soils, wherever there is the least danger of weeds rising, and even on clay soils, to be sown with grass-seeds, among winter-sown wheat, the row-culture in some of its forms, should be tried. But it will not do, to hold out the practice of Mr. Coke, or of any other gentleman, however eminent for his skill in farming, as a rule for universal imitation; and to censure those, whose soils and climates are of a very different description, because they refuse implicitly to adopt his system.

No. XVII.—*On Ploughing-in Green Crops for Manure.—By Edward Burroughs, Esq. of Watercastle, in Ireland.*

I HAVE tried many experiments on ploughing-in green crops, as a manure, and I have uniformly found, that they added much to the fertilizing properties of the soil. Vetches, and red clover, are particularly suited to this purpose, as they are very succulent, and grow freely on moist strong soils, although not in good heart, and by their overshadowing the land, and the decay of their inner leaves, produce much vegetable matter on its surface. On an experiment which I made on ploughing-in red clover, as a manure for wheat, I allowed the second growth to get up about seven or eight inches, before it was ploughed-in, in the principal part of the field; the clover on the other part was eaten low, and then ploughed, and sown in the same manner as the other part. The crop of wheat on that part of the field where the clover was in its luxuriance when ploughed-in, was very superior to the other part, both in quality and quantity. On a field of four acres, I sowed two acres with spring vetches, and left two acres in fallow. The vetches were consumed by soiling, and the land ploughed in the month of August for wheat, and sown in October.—The fallow adjoining was sown at the same time. The wheat, on the former part, proved uniformly better in every respect.

I laid out a field of six acres, (soil, strong clay), preparatory for wheat, in the following manner, viz. On two acres I planted potatoes; two acres were fallowed, and two acres were under winter vetches, (sown on wheaten stubble the preceding October). The potatoe crop was well manured, and the fallow well cultivated; the first crop of the vetches was cut for soiling, and the second crop ploughed-in when in blossom. The entire field was sown with red Lammas wheat in October, and produced as follows: viz. potatoe ground, best; vetch ground, very near equal in quality and produce; fallow, inferior.

I have often laid down land with vetches and grass-seeds, and I have observed, that they retain their fertility much longer than when sown with oats or barley for the purpose. In some instances, I have known grass-seeds to have failed when sown with oats, when under similar treatment they have succeeded when sown with vetches. From these and other experiments, I am satisfied, that the ploughing-in of *appropriate green crops*, is a cheap, effectual, and profitable mode of improving exhausted or light soils. With respect to the theory, which some farmers have advanced, "that by ploughing-in a green crop, you only return to the land the same proportion of vegetable matter, which was necessary for its production," it is as inconsistent as it is unfounded. It is well known that plants, especially of the leguminous class, are fed more by the atmosphere than by the soil; and it has been experienced, that lands have been in a higher state of fertility after producing a luxu-

riant crop of potatoes, than had they remained fallow. Rape is an excellent crop to plough-in for manure, as it is easily raised even on inferior soil, and from its oily nature, and the succulency of its tap-roots, it produces a great body of manure. The following curious and valuable experiment was tried by an intelligent farmer in the county of Kilkenny. He ploughed a ley field for oats, in the month of March, at the same time having a field of turnips immediately adjoining; he had the *tops* cut off, preparatory to their being pitted, and spread on the sward, before it was ploughed, to the extent of about twenty perches. The oats were sown at the same time on the entire of the field; but the crop produced from ploughing-in the green tops was materially better than on any other part of the field.

No. XVIII.—*Account of an Improved Mode of raising Crops of Grain, by means of a Drill-Barrow.*

THE most general modes of depositing the seed in the ground, at present, are, 1. Sowing it broad-cast on the surface; 2. Ploughing-in; and, 3. Sowing by a drill-machine. The advantages and disadvantages of both those modes, have been already explained (see Chap. IV. Sect. 11). It is here proposed, to give a short account of a new mode of sowing, by a drill-barrow, an engraving of which is annexed. For a number of years, it has been the practice in East-Lothian, to sow beans by such a machine; and several experiments were successfully tried, of sowing wheat, barley, and oats, by the bean-barrow, with a smaller cylinder, so that the seed might be properly sown. But an ingenious artist, Mr. Alexander Small, on Leith Walk, (son of the celebrated inventor of the improved Scotch swing-plough), has lately prepared some barrows for sowing grain, on so excellent a construction, that every objection to their use, is in a great measure removed.

The first idea was, to attach a box to the plough, so that the seed should be sown in the furrow, as the plough moved along. The plan of attaching the box to the plough, has certainly been attended with success, and in some cases may still be adopted; but upon fully considering the subject, it has, on the whole, been thought most advisable, to separate the box from the plough, for the following reasons: 1. By this means, when the box must be replenished with seed, a boy is only stopped, whereas when a plough is used, a man and two horses are hindered from working. 2. When the wheel is to one side, the plough is not so easily held; and, 3. The addition of the box, makes it more difficult to preserve the proper depth of the seed furrow.

The plan altered on these principles, may be thus described:

1. As soon as the plough enters, a boy with a box or barrow follows immediately, and deposits the seed in the furrow, which of

course is completely covered by the next furrow-slice. This is easily effected, even in windy weather, when sowing broad-cast is attended with difficulty.

2. The furrow-slice ought to be from two to three inches deep, in strong land, and from three to four in light; and,

3. The crop should be hand-hoed when a drill hoeing machine is not made use of.

The rows may be made either at ten or fourteen inches distance, but ten inches is considered sufficient by the generality of farmers, more especially where hand-hoeing is adopted. It is easy with a plough to make a furrow about ten inches wide; but where it is proposed to have a furrow of fourteen inches, it is necessary to have two ploughs, with narrow bottoms, to follow one another, each making a furrow of seven inches broad. Mr. Dickson of Bangholm, near Leith, has tried various breadths between the drills, as nine, ten, twelve, and fourteen inches, but on the whole, he prefers ten inches on light soils, because the wheat does not tiller, and the same breadth for oats and barley, though he thinks fourteen inches desirable, when wheat is sown on strong land, where it is likely to tiller much. The crops of grain and straw produced under this system, are fully as great, as under any hitherto tried. Mr. Hume of East Barns, had about forty-eight bushels per English acre; and Mr. Dickson, in a field of thirty-two English acres, sown by a box attached to the plough, had no less than fifty-one Winchester bushels per English acre, which was harvested, and carefully threshed on the 8th day of September, 1815.

If this system answers, according to the expectations that are formed of it, the cultivation of grain may be brought to a degree of perfection, which it has not hitherto reached. The whole plan is so simple in its operations, that there can be no difficulty in its execution. No expensive or complicated machinery is necessary; on the contrary, the same simple barrow, by raising or lowering the brush, or by an alteration in the size of the *flute* or hollow part of the roller used, will answer all kinds of crops; and besides the other advantages already stated, the crop, from being sown in rows, gets more air, is easier cut down by the sickle, and produces more straw, than when sown in a scattered manner; and being completely cleared of weeds, it can be harvested to much more advantage.

It is only necessary to add, that when a respectable farmer, to whom the country owes so much for the introduction of drilled turnips (the late William Dawson, Esq. of Graden), had the plan of sowing grain by the drill-barrow explained to him, he highly approved of it, and declared his full conviction, "that it would be the means of bringing the culture of grain to perfection, as the seed would have a level bed, and would receive an equal nourishment to bring it to maturity."

In a communication from Mr. Dickson (dated 16th August, 1817), he states, that in the unfortunate season of 1816, his

drilled crops were not so much sprouted as the broad-cast, and that the heads were larger, and better filled. His neighbour, Mr. Oliver of Lochend, finds drilling with a barrow equally advantageous.

But the great object is, that by means of this system, *even poor soils*, with a *moderate* quantity of manure, may be made to produce abundant crops. For that purpose, the following plan should be adopted. As soon as the ground is prepared for the seed furrow, let it be covered with moist and rotten dung, and then, either the seed may be sown in the furrow made, and the dung raked over it, or the dung may be first raked into the furrow, and the seed sown upon the dung, and then covered with the furrow-slice. It would evidently be a great advantage, to have the seed sown with *moist* dung, particularly for barley in dry springs; for it would always secure the crop of barley in the driest soils and seasons, wherever the plan of ploughing-in, is practised.

It would also be a superior mode of sowing turnips in rows, *without ridges*, for it is ascertained, that if the seed is sown *on* moist and rotten dung, it vegetates so rapidly, as to escape the fly.

No. XIX.—*Additional Hints as to Drilling, and Ribbing.*

SINCE the section on drilling *culmiferous crops* was drawn up, some additional hints, on that interesting subject, have been received.

Mr. Wilkie of Wimpole, states, that there is no difficulty in drilling stony land, provided a proper drill machine, called "*a lever drill,*" is made use of. The levers can be "*weighted*" at pleasure, and thus will answer in almost any soil, however stony, because that sort of soil is generally loose below, and better to drill on, than even heavy cloddy land, and the seed will stand a better chance of being covered.

Mr. Wilkie likewise observes, that the plants of wheat in drills, protect and nourish each other, through the winter, in consequence of which, a field in drills, will be more forward in spring, and also at harvest, than a field sown broad-cast.

Among the advantages of drilling, it ought to have been mentioned, that the crop being free from weeds, it can be harvested to more advantage, and sooner conveyed to the barn, or the corn-yard, than if it had been produced under the broad-cast system, in which less attention is paid to the destruction of weeds.

All farmers are agreed, that wheat thrives best *on a firm and compact bottom*, which prevents the roots from being long and straggling. Hence the advantage of having the roots rather *matted together*, provided there is substance enough in the soil to nourish the plants.

Mr. Checkett, an eminent farmer of Belgrave-hall, near Leicester, states, that he has raised fifty bushels per acre, by the drill; but never more than forty bushels by sowing broad-cast. He adds, "The advantages of the drill over the broad-cast system, are numerous, and decisive:—1. It enables the farmer to grow corn without weeds;—2. The crop is sooner ready for stacking after the scythe, or sickle;—3. It produces a cleaner, and more regular sample for the market; which consequently obtains a better price;—4. It leaves the land in a better state for a succeeding crop;—and 5. It materially increases the quantity of food for human consumption*."

Ribbing is much practised in Northumberland. It answers all kinds of crops, but not all soils. Strong clayey soils cannot be pulverized sufficiently for that purpose; nor can it be effected in a clover-lay, unless it be twice ploughed, and well harrowed. In Northumberland, ribbing is esteemed to be preferable to drilling, as there is the same opportunity of keeping the land clean; and the grain does not fall so close together, as by drilling†. But the more compact the roots, the less can they become loose or straggling, the better chance there is, that the crop will escape the rust or mildew.

No. XX.—*Hints as to Turnips, and on the best Means of preventing the Ravages of the Fly.—By Sir John Sinclair.*

THERE is perhaps, no vegetable, from the introduction of which, the agriculture of these kingdoms, has derived such essential benefits, as from that of turnips. They are not only of use as a fallow, for cleansing the soil from annual, and checking the growth of root-weeds; but they yield, at the same time, a weighty and profitable crop, peculiarly calculated for the maintenance and the fattening of live stock. It is a circumstance also, much in favour of the turnip plant, that in the later stages of its growth, it is, in a great degree, nourished by the atmosphere, as well as by the soil, and consequently, less exhausts its fertility, than culmiferous or grain crops. The close and deep shade which the leaves of turnips produce, has a most advantageous effect in rotting all below them; while the quantity of putrescent manure, in a solid or in a liquid form, which they are the means of furnishing, is greater than what is obtained from any other article whatever. Under the improved system of turnip-husbandry, a more correct style of management is introduced, by which our fields are cultivated like our gardens; and various crops, in judicious rotations, are successively rendered highly productive, without any additional manure, (when sheep are fed upon them in the field),

* See The Farmer's Magazine, vol. xv. p. 50.
† Farmer's Magazine, vol. xv. p. 52.

except what the turnips had received. There is no crop, on the whole, the culture of which has been brought to a higher degree of perfection, or which contributes more, to increase the value of the land, or the amount of its produce; yet in many districts, possessed of light, and loamy soils, and thence admirably calculated for the production of turnips, the farmers are often but little acquainted with the superior advantages of that plant*.

It is much to be regretted, that this most valuable article, is liable to be injured, and in many cases to be totally destroyed, by a small fly, or beetle, that attacks the young turnip, when just appearing above ground; at which tender period of their growth, the least puncture, in dry seasons, effectually kills the plant.

To prevent the ravages of this insect, various modes have been recommended, which may be arranged under the following heads: 1. Destruction of the fly;—2. Rendering the turnip less attractive;—3. Quickening its growth;—and, 4. Improving its culture†.

1. To destroy the fly, it has been recommended, to roll the land at midnight, while the dew is on the ground, by means of which these insects may be crushed against the moist earth. Boards have been smeared with tar, and drawn across the land, for the fly to skip on them, and be caught;—a trap has been invented, by which considerable numbers have been taken;—train-oil, and sulphur, have been used with the seed‡. Quick-lime, has been often suggested; and lime, saturated with ammonia in the preparation of gas, has been accurately tried; but all in vain.

2. To render the turnip less attractive, quick-lime has been used, sown when the dew was strong on the plants. The ground has been brushed with the leaves of the elder tree§. Turnips

* The proprietors and farmers of those districts of England, or Ireland where this plant is either little known, or imperfectly cultivated, who would wish to introduce the turnip culture, *in its greatest perfection*, in their respective neighbourhoods, might easily effect that object, by procuring some farm labourers from Scotland, by whom, in all its well-cultivated districts, it is almost universally understood.

† See a letter written by the intelligent and public spirited clergyman, the Rev. J. A. Rhodes, of Horsforth-hall, near Leeds: his letter is dated 29th July, 1820, and was printed soon afterwards in the Farmer's Journal.

‡ In America they afterwards mix the turnip-seed with ashes, or pounded gypsum, which promotes a rapid vegetation; and it is asserted in that country, *that it never fails of success*. For three seasons, steeping turnip-seed in train-oil, prevented the attack of the fly at Lord Orford's, in Norfolk; but after being steept in train-oil, *the seed was kept in salt pickle during the night*. Seven gallons of oil, was found sufficient to prepare seed for 200 acres of turnips. *Annals of Agriculture*, vol. xiv. p. 168.—Perhaps neglecting these "*minutiæ*," steeping the seed in saline pickle, or mixing the seed with pounded gypsum, occasioned the disappointment. Trials, with the addition of both these articles, ought to be made, by some public-spirited farmers.

§ To insure the success of this application, the leaves of the elder should be a little bruised, and fumigated with the smoke of burnt tobacco, mixed with a small quantity of assafœtida. *Transactions of the Bath Society*, vol. i. p. 92, and 93.—In this case also, *minutiæ* have been neglected. The dwarf elder, has also a more pungent smell, than the larger sort.

have been sown in the furrow, as well as on the ridge; and radish-seed, has been used in small quantities, the turnip-fly being particularly fond of the radish plant.

3. The growth of the plant is quickened, by the application of a proper quantity of suitable manure*, and placing it immediately under the plant. And,

4. The culture of the plant is improved, by sowing a great quantity of seed, (about three pounds per acre); also, by carefully weeding the crop, and frequently stirring the soil.

It is well known, where attention has been paid to the means of quickening the growth, and improving the culture of the plant, that the fly is not much to be apprehended. The plan of cultivating turnips *in ridges*, as originally practised by Mr. Dawson of Frogden, in Roxburghshire, and now established with so much success at Holkham, will certainly, in a great measure, prevent the ravages of that destructive insect;—but it is quite a mistake to suppose, that the plan is only calculated for such a soil and climate as that of Holkham, for it had long been previously adopted, not only in Roxburghshire, but in Berwickshire†, the Lothians, Northumberland, and other districts in Scotland and England.—Still, however, there are *ungenial soils*, as Mr. Rhodes very properly observes, where it would be desirable to cultivate turnips, and where very strong measures, for the destruction of the fly, would be of the greatest utility. It is, doubtless, a fair field, on which chemistry may exercise its powers; at the same time, if security can be obtained, by simpler means, it would be more desirable.

In looking over my notes on this subject, I find that other methods have been resorted to, for protecting the turnip crop, besides those enumerated by Mr. Rhodes.

Some have recommended taking the seed of the same year, and of a former year, and mixing them together. Then to steep one half of the seed, thus mixed, in water, for twenty-four hours, and then to mix the whole together. By this previous management, the turnips will rise *at four different periods;* and though the fly may destroy some of the plants, there will yet remain a sufficient quantity for a crop‡, more especially if the quantity of seed used, is at the rate of about three bushels per acre.

* Where it is practicable, more especially in dry soils and seasons, it would be desirable to have the manure rather in a moist state, than quite dry.

† The Reporter of the Husbandry of Berwickshire, states, that during fifteen years' experience, he had neither seen nor heard of any misfortune from the fly, except in a few instances.—See *Report of Scotland*, vol. i. p. 558.

‡ Donaldson's Modern Agriculture, vol. ii. p. 313. As the latest and freshest seed, will always spring up first, and the different portions of the mixtures will rise up at different times, the fly will naturally fasten on that which first appears; but when the second growth comes up, it will quit the first, and attack the second; the same preference will be given to the third, and the fourth, when they respectively appear, the youngest being always the sweetest, and the most palatable. Before the last is finished,

Mr. Wigfull, senior, of Sheffield, recommends, that twenty-four bushels of *the refuse* of kiln dried oats, (called *shudes* in Yorkshire), or the same quantity of very dry saw-dust, or any other substance that will absorb a large quantity of moisture, as fine earth in a dried state), shall be steeped for some days in putrid urine, and then mixed with eight bushels of soot, or of wood-ashes, and spread on the young turnips, as soon as they appear above ground; which, he is convinced, will prove an effectual means, of preserving them from the ravages of the fly.

An intelligent farmer in the neighbourhood of Edinburgh, (Mr. Johnstone of Hill-house), always thins or pricks out his turnips, *as soon as they appear above ground*, as they are certain of being in the *rough-leaf* next morning, and consequently out of danger*.

A very great improvement in the cultivation of turnips, in dry soils, without any mixture of clay in them, is, by applying *a heavy roller* to the turnip drills, instead of the light ones commonly used. The reasons are obvious. The soil being thus compressed, moisture is retained in it, and the gaseous effluvia, arising from the decomposing putrescent mass below, which nourishes the plants when young, not being suffered to escape too rapidly, which is often the case, their growth is promoted, and quickened. The soil also, being rendered perfectly smooth, the little vermin have no hiding places, in which they can shelter themselves.

Mr. Church, of Hitchill, an eminent farmer in Dumfries-shire, has ascertained, that it is the best mode of securing an early and regular vegetation, to sow the seed of the turnips, *on moist dung*, as soon as it is spread in the drills, and afterwards to cover the dung by the plough, but not quite so deep as usual. This practice is highly useful in dry soils and seasons, and should never be neglected, (as the expence of the seed is so trifling), where there is any risk of losing the crop for want of moisture. In a dry season, when the globe, and the Swedish turnips, did not vegetate, till a month after sowing, and the crops, after all, turned out but moderate, the turnips produced by this plan, attained a great size, (from 15 to 28 lbs. tops included), and many of them could not get larger for want of room in the drills†.

what remain of the former growths, will be so far advanced, and will have so harsh and bitter a taste, that the fly will not return to them again. Thus a sufficient quantity of plants may escape for a full crop.—*General Report of Scotland*, vol. i. p. 560.

* Forfarshire Report, p. 363.—This proves that stirring the ground is of use.

† Husbandry of Scotland, 1st edition, p. 266.—This idea of sowing on the moist dung, is peculiarly calculated for the row culture of turnips, *not sown in raised ridges*. Let the surface be covered with rotten dung. When a furrow is made, rake as much dung as is necessary into the hollow,—sow, by a drill-barrow, the turnip seed, on the dung, and cover it slightly with the next furrow-slice.—The crop is not then likely to suffer, either from drought, or from the fly.

But the following is the most effectual method, that has hitherto ben discovered, to insure the destruction of the fly.

As soon as the ground is completely prepared for sowing the seed, let a quantity of stubble, straw, furze, dried weeds, heath, wood shavings*, or any other sort of cheap inflammable matter, be spread upon the surface, and burnt upon the ground, moving the flame forward, from time to time, and managing it, if possible, so that the smoke shall spread over the field. This is easily done in those dry seasons, when alone the fly is to be dreaded. As soon as that operation is completed, the seed should be instantly sown.—The flame and smoke, either kill the insects, or compel them to take shelter, if any crevice can be found, in the soil, where they remain, until the young turnips are out of danger.—The heat also, thus applied, and the ashes thus produced, are of some use to the crop. Nor does it require a great quantity of combustibles to go over the field, merely for the purpose of destroying the vermin, by the heat, the flame, and the smoke. It is probable, (though the quantity has not yet been ascertained), that from one to two tons of stubble or straw, would be sufficient. The security of a crop of turnips would surely be cheaply purchased, by such a sacrifice; and if stubble is used, the object can be obtained, almost without expence.

The practice of burning straw, and gorse, on the surface of the soil, as a means of manuring it for turnips, has long been practised in the Wolds of Lincolnshire†. In Dorsetshire, however, it has been employed, *for the express purpose of destroying the fly, and with the greatest success.* The articles employed, are burnt in the manner above described; and an intelligent friend of mine, who farms in that county, has assured me, that it has succeeded on *alternate* ridges; and that the fly was destroyed, where the burning was applied; but that where the burning had been purposely omitted, for the sake of an experiment, the crop was ruined.

It is earnestly hoped, that the diligent farmer will avail himself of these hints, and will derive from them that benefit, to which his industry so justly entitles him.

133, *George-street, Edinburgh,*
25th December, 1820. J. S.

* Mr. Wigfull, senior, in his remarks upon this plan, recommends, that deal, and other wood shavings, should be collected from builders, joiners, carpenters, &c. in the nearest towns and villages, and conveyed in bags where wanted.

† See Young's Report of Lincolnshire, p. 267.—The quantity of straw used, when employed *as a manure for turnips*, was from four to five tons per acre; but much less would do, where spreading flame and smoke, over the surface of the field, is the sole object. It will only be necessary to use straw, for trying some experiments with burning, in the course of the year 1821. Industrious farmers, can afterwards find no difficulty, in collecting *as much stubble* as may be necessary, and stacking it in the field where the turnips are to be sown, so as to prevent the necessity of distant carriage at a critical period. By collecting weeds also, from the land, and even the sea, much good may be effected at a trifling expence.

No. XXI.—*Comparison between Horses and Oxen, as Beasts of Draught.—By Sir John Sinclair.*

THERE is no point that has been more keenly controverted, among, both practical and speculative agriculturists, than whether horses, or oxen, are best calculated for the operations of husbandry. Bold averments have been made, and much acuteness displayed, on both sides of the question, without its merits being as yet finally decided upon. We shall endeavour to state the arguments on both sides, and the results which may be drawn from the information we have collected.

Those who approve of employing oxen in the draught, argue, that they are purchased at from a half to a third part of the price usually paid for horses;—that they are subject to fewer diseases;—that while horses are liable to a number of accidents, and sudden disorders, by which great numbers are annually lost, oxen rarely suffer, so as to prevent their being fattened, and disposed of to advantage;—that oxen increase in value about 3*l.* per annum, during the time they are wrought; while horses, after they are above seven, or eight years of age, usually fall off in price, to much the same amount;—that as they are a more steady and regular draught than horses, they are peculiarly calculated, for ploughing strong, stony, or rough swarded old grass land*;—that though it is better, to require only about two-thirds labour from them, yet, when properly fed, that they can execute nearly as much work, in the same space of time, as horses†;—that while horses require corn in proportion as they are worked, oxen need only a moderate quantity of turnips and oat straw;—that in a maritime country, it is essential, that seamen should be provided with beef of a *superior quality*, which can best be procured from oxen, *who have gradually*, under the working system, reached their maturity‡;—and that while the horse is at last thrown into a ditch, and nothing recovered but his skin; the ox, after having laboured three or four seasons, will sell at from five to ten pounds higher, according to his size and condition, than when first subjected to the yoke§.

* Oxen move at a steady and persevering pace. In ploughing up old turf land, their motion in the plough being more steady than that of horses, the flag is less broken in turning over, which is a great advantage in the process of dibbling. Oxen, also, being steady, and not easily alarmed, are greatly preferable for cultivating reclaimed bogs, in which horses would fret, and plunge, or stick fast altogether, whereas oxen would be steady, and unalarmed.

† It is not fair, however, to expect, the same quantity of work from oxen fed on straw and turnips, as from horses fed on corn and hay.

‡ The flesh of young, or half grown cattle, never takes salt well.

§ All these arguments in favour of oxen, as applicable to turnip-land farms, Mr. Walker of Mellendean, in Roxburghshire, approves of, after an experience of thirty-five years.

The objections to the use of oxen, shall next be separately considered.

1. It is argued by those who are hostile to the use of oxen, that they are difficult to train, and on the whole less tractable than horses. This, however, is flatly contradicted by the advocates for the use of oxen, who maintain, that there is no more difficulty in training oxen than horses *;—that, when properly managed, they generally become sufficiently tractable, to be driven by a ploughman, without any other attendant, in the space of a few days;—that in all countries where the ox is the ordinary draught animal, his docility is proverbial;—that the want of success, in preparing oxen for the draught, is owing to inexperience, or has been occasioned by the obstinacy of servants, who will not take the trouble of training them;—and that any intractability, where it does exist, has arisen, from the animals having been only used occasionally with long and irregular intervals; during which the habit of discipline being broken, a new one is to be formed†.

2. It is objected to the working of oxen, "that they do not bear heat so well." To this it is answered, that the objection is unfounded in fact. The constitution of the ox, accommodates itself, as readily as that of the horse, to different climates. Not only in ancient Greece and Italy, but throughout Asia, as presented to us in ancient history, the ox and the plough are associated. At this day, in the warm districts of India and China, the ox, not the horse, is in the draught service. In every part of India in particular, the ox always appears, even in the train of her armies; and in the hottest parts of the West Indies, the ox is employed in hauling the weightiest produce to the sea-ports.

3. The next objection is, that oxen are slower in their movements, and cannot do so much work in a day as horses. This must, in general, be admitted; but in a lesser degree than is generally supposed. Where oxen are well chosen for their form—are not worked after they have reached their eighth year, (at which age they are best fitted to be fattened),—and are suitably matched, they may be brought to nearly as quick a step as the generality of horses, and to as quick a step as that of many horses, if aged, or ill fed.

Horses, in England, plough about a statute acre of stubble in the course of the day;—oxen about three-fourths of that quantity. After various trials, these have been found about the average per-

* Mr. Walker of Mellendean asserts, that where the method is understood, oxen are as easily trained as horses.

† See, an able paper on horses, and oxen, by Mr. Madison, formerly President of the United States of America, printed in "*The American Farmer*," published September 3, 1819, from which several hints are here adopted. In that periodical publication, there is likewise some valuable information, from George W. Erving, and Timothy Pickering, Esqrs. Indeed the subject seems to have strongly attracted the attention of the agriculturists of America.

formances of each*. But, in many cases, oxen have done more; and to accustom them to a greater quickness of movement, they should be trained upon light land, that they may acquire both a full, and quick step.

4. It is farther objected, that oxen, being weaker in the back than horses, are not so able to carry heavy burdens. But it is answered, that what they want in strength of back, is compensated, by the superior powers they possess in their neck. Hence their harness ought to be made, so that the draught should not be placed so much on their backs as that of horses, but chiefly on their necks, where their great strength lies.

5. It is next said, that oxen cannot bear extra work. This is a material objection, as the profit of a farmer, more especially in bad seasons, often depends on the getting his work done within a given time. In any unforeseen emergency, when a great pressure of work occurs, a horse may be fed up almost to any labour, however severe. But if an ox is pushed beyond his usual rate, he often sinks under his work, and is rendered useless for some time afterwards†.

Lord Somerville, however, maintained, that oxen are capable, not only of constant work, but of extra labour; and should a rest occur for a week or ten days, there is a profit attending their growth: this general profit, on an average, may be stated at twenty per cent. on their value; a circumstance much in favour of oxen‡.

The next objection is, that oxen are not calculated for the whole work of a farm. But here a distinction must be made between large and small occupations. Farmers who cultivate a great extent of ground, who pay full rents, and who live by their business, are almost universally of opinion, that the use of oxen alone would never answer, and indeed the total dismission of horses has been rarely thought of or attempted§. For long journies, and distant carriages, oxen are considered quite unfit, for they must have time to ruminate‖; nor can they well be employed, unless they

* Curwen's Report, p. 78.

† General Report of Scotland, vol. iii. p. 203. But Mr. Walker asserts, that by feeding oxen with *hashed oats*, he has made them do as much extra work as horses.

‡ Farmer's Magazine, vol. vi. p. 5.

§ His late Majesty, George the Third, devoted much attention to the cultivation of a considerable tract of land near Windsor. He used horses long enough to ascertain the heavy expence they work at, and he changed them *all* for oxen. It appears, that it required one hundred and seven oxen, to do the labour of the farm. They were fed on hay and straw, for twenty-six weeks in the year, and on grass during the remainder. The saving, by oxen, was at the rate of 513*l.* per annum, besides the value of the oxen disabled by accident, difference in attendance, and fewer casualties.—*Annals of Agriculture*, vol. xxxii. p. 168, where the details will be found.—The only doubt is, whether the horses were fed economically, and properly worked.

‖ Some maintain, that if oatmeal were given to oxen, it would enable them to undergo much longer journies, and in that respect, to approach nearer to horses. But still some rumination would be necessary.

are shod, either in frosty weather, nor on rough and stony roads*.

On the other hand, in regard to small farms, large horses are expensive to purchase, and to maintain; and though it may be desirable, to have a horse to go to market, yet for the labour of the farm, in general, oxen cannot be too much recommended†.

Another objection is, the loss of labour, on the part of the servant, where oxen are employed, which an eminent farmer calculates at from one-third to one-fourth of his wages‡.

The last objection to the use of oxen, is, the great quantity of *good land* that would be required for their rearing and maintenance; whereas it is desirable, to prefer that species of stock, that would furnish the greatest quantity of labour, from the smallest quantity of fertile soil, beginning with the animal at his birth.

Minute calculations have been made to ascertain this point, which, on the whole, are in favour of horses, as they will work out, in all, three successive pairs of oxen§.

Independently of the same work being done by a much smaller number of horses, they have, in several other respects, advantages over oxen. 1. They are better fitted for harrowing, a quick step being requisite to accelerate the pulverization of the soil: 2. During the harvest season, when expedition is so indispensably necessary, horses are greatly to be preferred: 3. Oxen do not continue for any space of time in the possession of the farmer, seldom above three or four years from the time when they begin to be employed in the draught. They must of consequence, be frequently bought and sold, which is attended with much trouble and expence; whereas horses will continue to work with the same farmer for several years, perhaps ten or twelve years from the time that they are first employed, and when they become unfit for severe labour, they are not thrown away, but can always be sold to higlers, petty carriers and others, to whom cheap horses are an object;—4. The use of horses in agriculture serves as a nursery for those wanted for the road, for pleasure, luxury, and amusement; and many farmers get their harrowing done cheaply by training up young horses, and giving them but slight work, until they are fit for the market||.

* Lord Somerville asserted, that oxen could execute road-work, even of the severest nature;—but he afterwards admitted, that they were liable to slight strains and lameness, arising from travelling on such roads.

† Farmer's Magazine, vol. xiv. p. 42.

‡ If the wages of a farm-servant, every thing included, is 2*s*. per day, it is maintained, that from 6*d*. to 8*d*. per day is lost, if he is employed in working oxen, instead of horses.

§ General Report of Scotland, vol. iii. p. 198, where this point is minutely examined.

|| Communications to the Board of Agriculture, vol. v. p. 364.

Conclusion.

We shall now proceed to state the results of the inquiry.

The great object of a farmer ought to be, to obtain that species of working stock, which is best calculated to perform, all that routine of labour, which the soil, situation, and other circumstances of the land he occupies, may require*.

In former times, oxen were almost exclusively employed in the labours of agriculture, but they have long been gradually getting into disuse; and the custom not being re-established in this country, notwithstanding a heavy tax on horses†, from which oxen are exempted; it would be absurd to suppose, that the preference given to horses is not founded upon solid grounds‡.

It does not appear, that horses are superior to oxen in docility, or ability for work of various kinds; nor are they, in any respect, more hardy; but they are possessed of more general applicability to labour, from their conformation, agility, and better feet§. Hence, in all improved countries, since the labours of agriculture have become, not, as formerly, irregular and desultory, but uniform and constant, more especially on high rented farms, where the operations of husbandry are carried on, with unceasing attention and industry, horses are preferred, as the best and principal resource on which the farmer can rely.

There are certain situations, however, where a considerable profit may be gained, by employing *a proportion of oxen*, instead of horses, in agricultural labour. This profit principally arises from three causes—1. an increase of manure;—2. a saving of food;—and, 3. their improving in value, from the time when they begin to work, to the time of their being sold. They are likewise less subject than horses, to sudden death, accidental injuries, and occasional maladies||.

The next points to be discussed, are, 1. In what description of farms a proportion of oxen can be used to advantage? and, 2. What the number of oxen ought to be, where they are admissible?

1. *Farms calculated for a Proportion of Oxen.*

Where oxen must be maintained, with corn or hay, the feeding is so very expensive, that it cannot be advantageous to employ them to any extent.

* Farmer's Magazine, vol. xiv. p. 275.

† The tax on horses employed in agriculture, ought certainly not to be extended to breeding mares. Even that exception would be thankfully received by the farmer.

‡ The late Lord Somerville, was the great advocate for oxen. He calculated, there were 600,000 plough and cart horses in England, one half of them superfluous, while the land that would be required to feed a horse, he said, would support seven or eight human beings.

§ Coventry's Discourses, p. 171.

|| Farmer's Magazine, vol. xiv. p. 439.

In the neighbourhood of towns also, where straw, and every species of green food, as turnips, grass, &c. are higher in price than at a distance from them, the employment of draught oxen must proportionably be less profitable or advantageous*. On the other hand, there are few situations better calculated for oxen, than farms distant from market-towns, where putrescent manures cannot be purchased, but where turnips can be raised in considerable quantities, because that description of food is not only cheap, but it is peculiarly conducive to their health and improvement. On turnip-land farms, they may likewise be employed, not only in ploughing, but in hoeing the turnips, in carting cut grass for soiling, and for other agricultural purposes about the farm.

But the best description of farm, for the use of oxen, is, where there is abundance of coarse and bulky herbage, favourable to the breeding of cattle; and where the land in occupation is so large, that there is a regular succession of ploughing, (unless in frosty weather), during the whole year†. On such a farm, oxen may be both reared, and employed as working stock.

2. *Proportion of Oxen on a Farm.*

In regard to this point, practical farmers, who approve of a partial use of oxen, do not materially differ. On one farm, where twenty horses would be required, for the whole labour, the proportion adopted is, sixteen horses and eight oxen. On a larger farm, the occupier keeps twenty-two ploughs drawn by horses, and eight by oxen; and it is stated, that the proportion of oxen would be greater, were it not for the necessity of long journies, or carriage of grain to market. But the most important examples on very large farms, are those of Mr. Walker of Wooden, and Mr. Walker of Mellendean, both strong advocates for the partial use of oxen. These gentlemen keep on their farms fifty work horses and twenty-eight working oxen; and they calculate that the expence saved on each plough worked by oxen, is at the rate of 22*l.* 15*s.* per annum, besides the annual increased value of the oxen ‡.

On all farms also, where the climate is precarious, and where, on that account, it is desirable to have some "*extra stock*" at command, oxen, being more cheaply maintained than horses, are entitled to a preference; and certainly may be advantageously employed in ploughing, in rolling, in carting dung, or turnips, in threshing mills, and for short carriages in general.

* Farmer's Magazine, vol. xiv. p. 434.

† General Report of Scotland, vol. iii. p. 203.—This observation, however, is not applicable to the fen lands of England, where keeping and working brood mares, for breeding dray and waggon horses, pays better than rearing and working oxen. Besides, on low fen land, (peaty), oxen cannot be reared in a healthy state, owing to the *scour* to which they are subject.

‡ Husbandry of Scotland, first edit. p. 113 and 114.

Sir Thomas Carmichael of Skirling, estimates that a pair of oxen is less expensive than a pair of horses, to the amount of 27*l.* 11*s.* per annum.—*Farmer's Magazine*, vol. xiv. p. 43.

It may be proper to add a few general observations on the use of oxen.

1. It is advisable, to begin working oxen, as early as two or three years old, but in such light work, and so moderately, as not to prevent their growth.—It will then be easier, to correct their faults and bad habits, which some are apt to get into.

2. They should always be worked with the collars reversed, that is, the broadest part uppermost.

3. Where a proportion of oxen are kept, those of a small size, or with light frames, ought to be avoided, for they cannot be fully master of their work, or made to move expeditiously in the plough. Nor should they be selected for their great size, for in that case, they are soon exhausted by their own exertions. Those of a moderate size, whose form denotes superior agility and vigour, ought to be preferred. Oxen with short legs, have likewise been found the best labourers*.

4. In the management of oxen, it is particularly desirable, (except during the depth of winter), that they should be worked in two journies, or yokings, in a day, that they may have sufficient time to ruminate in the interval.—For that purpose, they should begin to work very early in the morning.

5. It is an excellent plan to keep three oxen for each plough, and to work only two of these at a time, alternately. Thus each ox is only four days in the yoke every week.

6. A much greater proportion of labour on a farm might be done by oxen, if they were shod. When oxen are worked on hard stony roads, or obliged to go over rough frozen ground, they suffer so much from the want of shoes, that true economy requires, they should have that accommodation as well as horses†. As yet, no shoe has been made in Europe, that will enable oxen to walk with ease and safety on hard dry roads, or on frozen ground. The great difficulty in forming such a shoe is, that the iron must be divided, otherwise sand may get between the iron and the hoof, and create wounds and sores ‡.

* Mr. Knight observes, that the more deep and capacious the chest, and the shorter and the lower any animal is, relative to its weight, the better adapted it will be to live and fatten upon little food, and more labour it will go through. Mr. Marshall also, in his Rural Economy of Gloucestershire, says, that the best labouring ox he ever saw, had the shortest legs.

† It is said that they have discovered an improved mode of shoeing oxen in *New England*, an account of which would be desirable. Mr. Pickering has suggested to "*The Massachusetts Society for promoting Agriculture*," the propriety of communicating to the author, a drawing and description of the simple frame and apparatus, invented in New England; for the information of British Agriculturists; to whom, (as Mr. Pickering with much liberality observes), "the farmers in America are so much indebted for instruction and examples, in the most approved practices of husbandry." (See "*The American Farmer*," vol. ii. p. 139).—It is to be hoped, that such friendly feelings of reciprocal good will, will not only exist between *the farmers*, but will be felt by all the other classes in the two countries.

‡ When fat and heavy oxen get lame on the roads, going to market, they

7. One great reason why oxen are not much employed, is the difficulty of getting them purchased *ready trained.* If they could be bought fit for use at market, as horses are, they would be much more in demand. It would certainly, therefore, be an object in districts, possessed of a good breed of cattle, and partly cultivated; instead of rearing cattle for the grazier, to supply the arable farmer with such a number of young oxen, ready trained, as he might require.—Such a plan, would be equally advantageous to both parties*.

Such are the results of a very extensive, and minute inquiry, into this much controverted subject. Where the reader is not satisfied with the opinion given, he is furnished with the materials, of forming another, better entitled to his adoption†.

133, *George-street, Edinburgh,*
1st February, 1821.

No. XXI.—*On Blue Vitriol, or the Sulphate of Copper, as an infallible Remedy for preventing the Smut in Wheat,* and so strengthening the Plant, *that it is less subject to other Disorders.*

Together with some additional Hints, as to the Rust, or Mildew, by Sir John Sinclair.

IN the course of some extensive inquiries, made for the purpose of discovering, whether any practices prevailed on the Continent of Europe, that would be of use to this country; I was particularly anxious to ascertain, what means were adopted, for preventing the disorders of wheat. It seemed to me in particular, a circumstance that ought to be thoroughly investigated, that though Flanders and England are so near each other, and do not materially differ in soil or climate; yet that there should be so great a

are shod. They are *cast* with a hopple, and two plates of iron are nailed on each foot. But little pains are taken to pare the hoof, but the nails are driven a good deal aslant.

* In Scotland, the counties of Angus and Aberdeen are districts, which seem to be peculiarly calculated for such a traffic. If a demand for *trained oxen* were to arise in England, it might be supplied from those two counties in great numbers, by cattle-dealers who at present solely purchase cattle for feeding.

† The mule seems, in point of economy, to be between the ox and the horse, preferable to the latter, inferior to the former, but so well adapted to particular services, that he may find a proper place on many farms. He is liable to the objection which weighs most against the ox. He is less fitted than the horse for road service.—See Mr. Madison's paper, already quoted.

difference between the prices of the two countries, at the same periods of time, as appears from the following table:

Year.	Prices of Wheat per quarter in Flanders.	Prices of Wheat per quarter in England.	Difference between the prices in Flanders and in England, per quarter.
1805	£3 17 7	£4 7 1	£0 9 6
1811	3 17 11	4 12 5	0 14 6
1812	3 5 7	6 2 8	2 17 1

It is hardly possible, that such a circumstance could have taken place, unless, by some means or other, wheat was not liable to the same destructive maladies in Flanders as in England.

In the course of my inquiries, I was fortunate enough to obtain, not only the preparation made use of in the Pays de Waes, (the best cultivated district in Flanders), but also another mode of using copper, discovered by a celebrated chemist and naturalist, M. Benedict Prevost of Geneva, which is reckoned on the Continent, not only efficacious, but, when properly used, *infallible*.

Having frequently recommended this preventive against the smut, after my return from the Continent, I flattered myself that its efficacy would soon be tried by a number of zealous and experienced farmers.—But it is a true saying, in regard to agriculture, as well as in many other arts, "*What is every body's business, is nobody's.*"—Each individual wishes to throw the load off his own shoulders, in hopes that his neighbour will undertake the trouble and risk of the experiment.—Hence, this important suggestion might have remained unnoticed, had it not fortunately attracted the attention of some public-spirited agriculturists in the town, and neighbourhood of Birmingham.—To them, the use of the *sulphate of copper*, (from their being more accustomed, than the generality of farmers, to articles connected with manufactures and chemistry), was not an object of apprehension.

Mr. Richard Hipkys, of Paradise-street, Birmingham, was the first person, at least in that neighbourhood, who was prevailed upon to try the powers of the proposed application. He states, that in the autumn of the year 1817, he met with a small work, written by the President of the Board of Agriculture, in which the sulphate of copper was recommended as a remedy against the smut. —That he had no faith in steeps, from the previous want of success in the use of them, notwithstanding the application of the usual remedies; having had considerable breadths of wheat, rendered absolutely unsaleable, *for the four preceding years*, by the ravages of that destructive disease. Yet to gratify the wishes of an esteemed friend, he was induced to make a trial that year. That in the course of his experiments, he found his crops were free from disease, exactly in proportion to the quantity of sulphate used.—That having ascertained there was no hazard in the operation, he caused the whole of his seed wheat, used in autumn 1818, and also some Talavera wheat that was sown in the spring of 1819, to be prepared in the manner to be afterwards described. The result

was, that by the use of blue vitriol, he had a beautiful crop of wheat, entirely free from smut, *and every other disease.*

In the autumn of 1819, he sowed thirty-three acres of wheat, and in the spring 1820, nine acres of Talavera and Cape wheat, prepared in the same manner. The result at harvest, was again, crops of grain *entirely free from disease.*

In the seed time of 1819, Mr. Hipkys induced a particular friend, whose soil and situation were perfectly different, to make a trial of the sulphate, which he did with the most satisfactory and decisive results. The particulars have been detailed by Mr. Hipkys, in the Farmer's Journal, at that gentleman's particular desire. Letters subscribed by him, have been transmitted to me, and though he declines having his name mentioned, there can be no doubt, that the facts he states, may be confidently relied on.

The success of this plan of preparing wheat, being thus placed beyond the possibility of doubt, it is proper to state: 1. The nature of smut;—2. The improved mode of preventing it;—and, 3. The advantages attending the practice.

1. The nature of smut, is now well known. It is a small and delicate microscopic plant, which would soon be destroyed by the variations of the atmosphere, if wheat did not offer an asylum, where it could propagate itself. While it is only attached *externally* to the grain, and before its seeds, or germs, have penetrated into the plant, its germination may be effectually prevented, by any operation that will clear the grain of the smutty powder, or that destroys it by acrid, corrosive, or poisonous applications. If nothing effectual is done for that purpose, the smut penetrates into the plant of the wheat, while it is still very young. There it produces globules, which increase with the ear, and become perfect seeds, when the wheat approaches to maturity. If, however, the seed is fortified by a solution of copper, it not only destroys the germination of any smutty powder attached to the grain, but it likewise prevents its being attacked, through the root, by any other parasitical plant that may be found in the soil, and thus may escape other accidents, or disorders to which wheat is liable*.

2. The mode of using the blue vitriol, adopted by the gentleman whose name is not disclosed, is as follows: Into eight quarts of boiling water, he puts one pound of blue vitriol; and while it is quite hot, he mixes three bushels of wheat with five quarts of the liquid, and at the end of three hours, adds the other three quarts;

* Mr. Hipkys states, that he had a superior crop of wheat, which had been sulphated, and escaped being lodged, while the field of a neighbour, of equal quality, was beat down, and mildewed. This he attributes to the superior strength of the straw. He is not of opinion, that the sulphate will prevent the mildew; all that can be expected from steeps, is, that through their instrumentality, the plant may be thereby freed from a general aptitude to disease, and by being thus invigorated, it may be the better enabled to withstand those attacks, to which, in a less healthy state, it would be liable.

and the three bushels of wheat are suffered to remain three hours longer, or six hours in all, in the liquid. The whole should be stirred three or four times, during the six hours, and the light grains may be taken off. Then add a sufficient quantity of slaked lime, to make the wheat perfectly dry. It may remain in a heap for six hours; it may then be spread open, and used the next day, but not sooner. Though it is recommended to be spread six hours after it has been limed, and put in a heap, yet there is no risk of its heating, and it may be kept longer than a day, without any risk of injury.

Mr. Hipkys's mode of preparation is different. After dissolving five pounds of the sulphate in hot water, he then adds as much cold water as may be sufficient to cover three bushels of wheat; which is gradually passed through a riddle, in order that all the light grains may swim on the surface, and be skimmed off. After being repeatedly stirred, and cleared of the light grains, the wheat is suffered to remain in the liquid for five or six hours; but it has remained, in one or two instances, from twelve to twenty-four hours, without experiencing any bad effect. It is then taken out, and thrown upon the floor. If it is to be sown broad-cast, it should be crusted with lime in the usual way; but for drilling, it is stirred about until it becomes dry, which it generally is, in dry weather, in five or six hours. When the atmosphere, however, is moist, it will require double that space of time*. It may then be drilled, with as much facility as grain that had not undergone any operation.

After the first two or three bags, of three bushels each, have passed through this liquid, one pound of the sulphate should be added, for each succeeding bag, until from ten to twelve bags have been thus used; when a fresh quantity of the preparation should be made ready, in case the liquid should become foul or turbid.

Either of these modes may be adopted with a certainty of success.

3. This plan is surely superior, in point of cleanliness at least, to some of the disgusting processes that are frequently recommended for the same purpose; and is likewise attended by the following advantages:—1. The expence is trifling, as the price of the vitriol is not, in general, above from sixpence, to eight pence, or nine pence per pound; and after being used, in the manner above described, the water may be evaporated, and the remains of the sulphate will again crystalise.—2. It is a great advantage, that, with this preparation, liming is not necessary; as lime, *more especially recently slaked*, cannot always be had, and as the use of lime is so injurious to the drill machines, where brushes are used.—3. It is well known, that after wheat has been steeped in other modes, it has been lost by keeping; whereas, when prepared by the sulphate, it may re-

* Passing it through a pair of fanners, would soon dry it.

main unsown for any space of time without injury* ;—and, 4. The plant is thereby so strengthened, that it is less liable to be lodged, or to suffer from other disorders; and though it does not prevent the rust or mildew, yet for the smut, when properly applied, it is an *infallible antidote.*

In order to do justice to the application, the grain should be perfectly dry, when the solution of copper is applied. The germination of the smut plant will then be effectually prevented, without injuring the vegetative powers of the wheat.

It may be proper to add, that M. Prevost's discovery was, in a great measure, accidental; that the utility of preparations from copper, has long been tried in Flanders. It has also been successfully employed by Mr. Joseph Butler of Killamarsh in Derbyshire†. Mr. Brownrigg, in the county of Wicklow in Ireland, likewise uses vitriol‡.

Additional Hints on the Rust, or Mildew.

It was formerly supposed, that thick sowing in drills, was an injudicious practice, on the idea, that the roots being *matted together,* were consequently less likely to be productive, as when the seed was scattered more evenly over the surface, and each had a separate field for nourishment; but the following experiments prove that the idea was erroneous:

1. Fifteen holes were made, one foot separate, with the common dibble, in land well manured, into the first of which, one grain was put, and the number of seeds was progressively increased in each succeeding hole, till they amounted to fifteen. From hole one, to hole eight, inclusive, the plants, on an average, produced each *from seven to eight stems,* the ears were perfect, and scarcely any light or imperfect grains were to be met with; but from hole nine, to fifteen, inclusive, there was a progressive falling off; the last, or number fifteen, produced the worst return.

2. Another experiment of a similar description was tried, with land *not manured,* when the average, from hole one to three, was *three stems each,* of perfect ears. The produce, from hole three to fifteen inclusive, was gradually less, some disordered, and some even smutted.

The result of these experiments is, that thick sowing, if not carried to an extreme, *is not inconsistent with great produce.* In-

* It would be a good plan, for seedsmen to prepare the seed-wheat before they send it to their customers. Sulphated seed has been kept, uninjured, in small quantities, from the 2d of November, to the 24th of December.

† See Derbyshire Report, vol. ii. p. 116. He mixed two pound of blue vitriol, in as much chamber-lye, as would wet twelve bushels of wheat, and after soaking, dries the wheat in quick-lime.

‡ Report of the County of Wicklow, by the Rev. Thomas Radcliff, p. 256. Mr. Brownrigg dissolved only a quarter of a pound of Roman vitriol, in warm water, and mixed it with one barrel of sea-water, strengthened with a stone of salt.

deed the stems, though close at the root, yet diverge considerably as they ascend, and hence have abundance of room for bringing their ears to perfection.

The next point is, to explain on what principles thick sowing prevents mildew.

It is well known that loose and open soils, such as turnip lands, are the most liable to that disease, and the reason is, that the roots in them are the largest, the longest, and often, in search of moisture, run the deepest into the soil. The stems are thence luxuriant, large, and porous. The roots being long and straggling, often get into a noxious stratum below, or into one not productive of nourishment. When that is the case, the plant, formerly luxuriant, meets with a sudden check, (for it is only from the extreme point of the roots, that the plant derives its food by absorption), and this sudden check, predisposes it to disease. If then the month of July is accompanied by warmth and moisture, the plants of wheat, in their weakened state, will be attacked by those *fungi*, to the propagation of which that description of weather is so favourable, more especially in places where a free circulation of air is wanting.

In proof of these doctrines it may be observed, that in loose and open soils, *treading the land thoroughly*, after it is sown, is an effectual preventive of the mildew. The roots are thus prevented from becoming long and straggling, or getting into poor or noxious strata, whence no nourishment can be derived. The more effectually the soil is trodden the better, as it destroys vermin in the ground, as well as prevents mildew. Some farmers employ a flock of sheep for that purpose; others, pigs; and some have employed even cattle and horses, with much advantage*.

The reader will at once perceive, from the preceding observations, the advantages of thick sowing. The roots, instead of being long and straggling, are short and numerous. They are retained in the soil that has been prepared for their reception, instead of wandering into strata either poor or noxious. From the number of these roots and stems, that richness, that would be injurious to a few plants, only does justice to a number; for the same quantity of dung that might give twenty stems a disposition to disease, would only yield a proper quantity of food, when it had fifty to nourish. By thick sowing, all the advantages of treading, *in so far as respects mildew*, will be obtained.

On these grounds, I am much inclined to think, that the thick sowing of drilled crops may be found an effectual means of preventing mildew; and I hope that a number of active and intelligent farmers, will try, in the course of this season, such a number of experiments, as will put the question at rest. This may be effected by sowing, both in drills, and broad-cast, various quantities of seed, from one to four, or even in some cases to try the

* See Code of Agriculture, Second Edition, p. 319 and 367.

effect, of five or six bushels per acre, and recording, in the Farmer's Journal, the result, in regard both to disease and produce; with a particular description of the roots of the different crops, whether sown thick or thin, and whether they are diseased or otherwise.

I have no doubt, if the investigation of this subject is pursued, by the intelligent farmers of the United Kingdom, with that energy which its importance so justly merits, that some means will be discovered, which would prevent this disease from being, not only injurious to the individual, but the source of much national calamity.

N. B. It is supposed that *salt* is of use in preventing mildew. If any farmer can give any information upon that head, it would be highly acceptable.

133, *George-Street, Edinburgh,*
3d February, 1821.

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EXPLANATIONS OF THE PLATES.

PLATE I.

Plan of Farms and Farm-Buildings.

This plate is intended to give an idea, of the most advantageous arrangement of a Farm, and its buildings, hitherto suggested, and the most eligible rotations of crops, whether in a strong or in a turnip soil.

No. 1. Is the plan of a strong loamy, or clay-land farm, of 300 acres, divided into six fields, of 50 acres each; under the most productive rotation for such soils, namely; 1. Fallow, or fallow crops; 2. Wheat or Barley; 3. Clover; 4. Oats; 5. Beans; 6. Wheat.

No. 2. Is the plan of a turnip-land farm, of 400 acres, divided into eight fields of 40 acres each, and four fields of 20 acres, under a rotation of four crops, 1. Turnips, or other green crops; 2. Wheat or Barley; 3. Clover; and, 4. Oats: but it is in general advisable, to have one or two years' pasture, after the clover, to insure an abundant crop of oats; hence this is likewise a rotation of six crops.

The house and offices are supposed to be situated in the centre of the farm, the advantages of which are very great. The farm-house to be placed either in the front of, or behind the garden, according to circumstances. The corners to be all rounded, to prevent accidents to carts. The threshing-barn and mill, with its horse course, to be adjoining to the corn-yard. The yard to be so intersected by roads, that every stack may be accessible at any time, to be easily conveyed to the barn. The ponds and well, to be conveniently situated. The houses and gardens for the farm-servants, to be at a moderate distance from the house. The corners of the fields only to be planted, and the hedges to be kept low, for the admission of air, and to prevent vermin. An industrious farmer, could well afford to pay from one-fourth to one-third more rent, for a farming establishment constructed on these principles, compared to the confused and inconvenient manner in which farms are usually laid out.

PLATE II.

Descriptions of the Improved Swing-Plough; the Grubber; and Mill for making Pot-Barley.

No. 1. This represents the left hand, or land-side of the improved swing-plough, when completed. A B, the beam; B C, the left-hand stilt, or larger handle; D E, the coulter; D F G, the sock or share;

PLAN of FARMS and FARM BUILDINGS.

Plate 1.

No. 1.

Plan of a STRONG LOAM or a CLAY-LAND FARM *of 300 Acres*

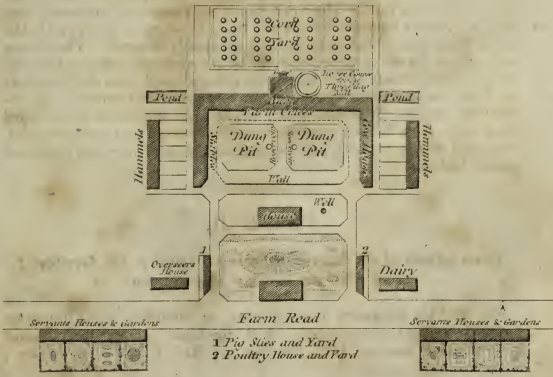
No. 2.

Plan of A TURNIP LAND FARM *of 480 Acres.*

The above are the most profitable systems of rotation, either in Strong Land, or in Turnip Land Farms, but where the Land is not rich, nor in the immediate neighbourhood of dung, it will be necessary to have one or two years pasture after the Clover, to insure an abundant crop of Oats.

No. 3.

FARM HOUSE AND OFFICES.



The House may be situated in front or behind the Garden, according to circumstances.

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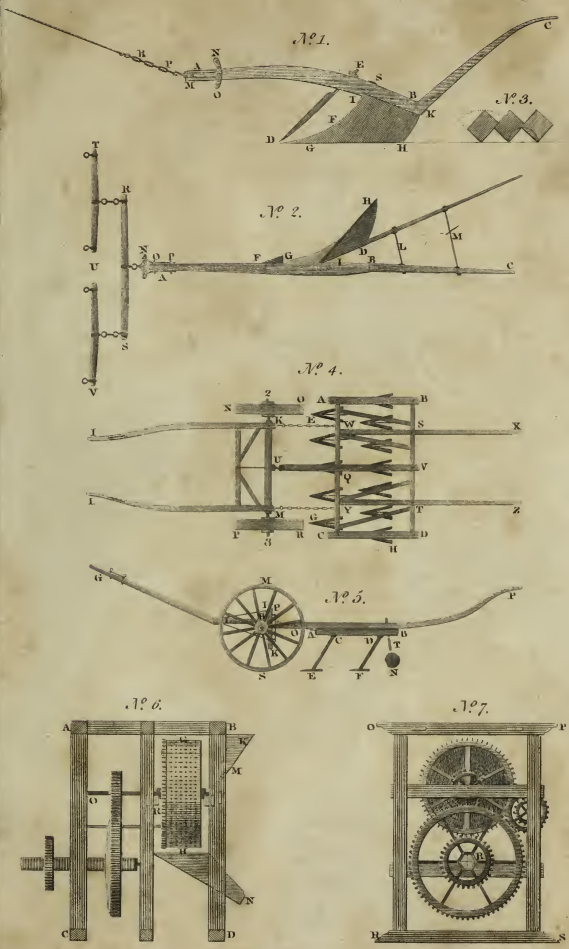
Engravings of the Improved Swing Plough, Grubber, and Pot-Barley Mill.

Plate 2.



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I K G H, are cast-iron plates, nailed on the land-side of the plough, to prevent the wood from wearing; K.H the back-end of the mould-board; S, the sheath; M N, the muzzle or bridle, placed upon a bolt that passes through a hole in its arms, and fore-end of the beam at A, on which bolt it has liberty to turn, to give the plough a greater or lesser hold of the ground. N O, a cross, fixed on the back part of the bridle, having different holes, to receive a bolt that pasess through any of them, and a hole in the beam; by this bolt the bridle is kept steady, when placed in the proper position for causing the plough to penetrate to the intended depth in the ground. P R, the swing or cross trees, and chain of draught, attached at M to the beam.

No. 2. This is a plan, or bird's-eye view of the same plough. A B, represent the beam; B C, the larger handle; and D, the lesser handle fastened to the larger one by the rods L M, which hold them at a proper distance from one another. G D, the lower edge, and I H, the upper edge of the mould-board; F G, the sock and feather; N P, the bridle, placed upon a bolt which passes through a hole in its arms, and the fore-part of the beam at O, by which it is attached to the beam; R S, the larger cross, or swing-tree, fixed by a chain to the fore-part of the bridle N, having several holes, into any one of which the draught may be fixed, according as the furrow-slice is required broad or narrow. T U V, the lesser swing-trees, attached at R S, by iron chains, to the larger one, and to them, the cattle are yoked when ploughing.

No. 3. Shews the angle at which the furrow-slice is placed, when this sort of plough is made use of.

No. 4. Plan, or bird's-eye view, of a grubber, with eleven shares, A B C D, represent a strong wooden frame, into which the arms of the shares, or claws are inserted, and secured on its upper side by screw nuts, so that they may easily be taken out when requiring repair, and to increase a or diminish their number at any time, if found necessary E G, represents five, and H six, of the shares placed so as to move at equal distances from each other; by which they cut up the wee 's in their progress, and loosen the soil a few inches deep. I K, and L M, the shafts, or timbers, by which the machine is drawn. N O, and P R, are two wheels, that revolve upon the iron arms 2 and 3, which arms are fixed by screw-bolts on the wooden axle, at the ends K and M. The regulating beam U V, is fastened upon this frame, at Q and V, with screw-bolts, and attached to the axle at U, by an iron-bridle. K W, and M Y, are two chains, fastened to the shafts at K and M, their other ends passing through holes in the side rail of the frame at W and Y, in which they are secured by screw-nuts. These chains yield, and allow the shares to rise up or down, according to the inequality of the land. S and T, are two cylinders, the pivots of which turn in the lower part of iron arms, which can easily be shifted either up or down, in order to regulate the depth that the shares are intended to penetrate the soil.

No. 5. Profile of the same instrument. A B, represent a wooden frame, into which the iron arms C D, are inserted, and secured above by screw-nuts; upon the lower end of these arms are welded the shares E and F, which penetrate the land to a small depth, and cut up the weeds as they pass along. G L, represent the shafts or limbers, fastened on the axle by iron bolts. H, is a piece of wood fixed upon the wooden axle; and into this piece of wood, are fastened iron bolts, having eyes to take in the iron rod P K; which rod passes through a hole in the beam O B, at H. By this means, the beam has freedom to

move up or down on the rod, and can be fixed to any part of it, in order to make the foremost shares go either deeper or shallower in the ground. M S, represent one of the wheels, which revolve on the axle, that carries the hindermost end of the shafts. N, represents one of the cylinders, the pivots of which turn in the iron arms T. These cylinders hold the back end of the wooden frame A B, at an equal distance from the surface of the land, and of course regulate the depth to which the shares are to penetrate the soil. B P, one of the handles by which the machine is directed, when at work.

No. 6. Section of an improved machine for making pot or pearl barley. A B C D, represent a strong wooden frame, which carries the machinery; E F, an axle, upon which is fixed the toothed wheel, No. 1. which may be turned by any machine having sufficient power; or a water-wheel may be placed on the same axle, for that purpose. No. 2. represents another wheel, fastened upon the axle E F, to drive the wheel No. 3, which is placed on the iron spindle O P; and upon this axle the mill-stone is also fixed. (See I K, in fig. 3.) G H, represent the curb or case, that encloses the mill-stone and barley, when making. No. 4. a wheel fixed upon the case G H, turned by a wheel and a pinion. R S, are bearers, in which the case, G H, revolves when the machine is at work. K, a hopper, to contain the rough barley. M, a spout, or pipe, which conveys the barley into the case at P: in the circumference of the case G H, is an opening, having a valve, or shutter, which allows the barley to issue out into the spout H N, that conveys it down to the trough, or mill floor.

No. 7. Profile of the same machine. O P R S, represent a perpendicular frame, in which the wheel and mill-stone revolve. No. 1. represents a toothed wheel, fixed upon the axle R, and may be attached, or turned, by any machine driven by water, by wind, or by cattle. No. 2. a wheel, also fastened upon the axle R, having teeth in the circumference to turn the wheel No. 3. which is fixed on the iron spindle, or axle, that carries the mill-stone; and case T U, which encloses the stone, and contains the barley. The circumference, and both sides of the case T U, are covered with sheet, or plate iron, in which are small holes, that allow the dust, or small refuse to pass through; at the same time retaining the barley, till sufficiently clear of the husk. The frame of this case, is made to separate in the middle at T U, and is fixed together by screw-bolts, so that it can easily be placed on the mill-stone, or taken off at any time if necessary.

The machine above described, performs the operation in a safe and proper manner, without either breaking or cutting the grain. The advantages of this process are very great. Pot-barley is a most wholesome food, and is well entitled to the name of "*European rice.*" It may be consumed in the same manner as rice, either boiled with milk, or ground into meal, and made into puddings. It makes excellent cakes, and mixed with wheat, in a proportion of one-third, or one-fourth, it makes bread of a quality scarcely to be distinguished from bread made entirely of wheat. It is supposed, that the flour of barley is the wholsomest of any, it makes the purest blood, and is particularly calculated for bilious people. The refuse is an excellent food for horses.

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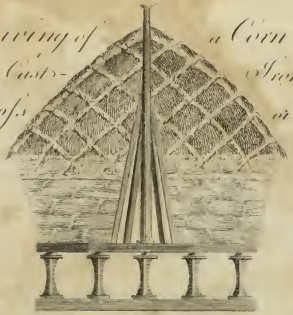
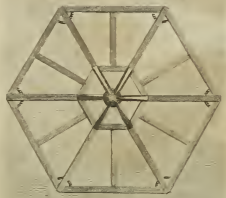
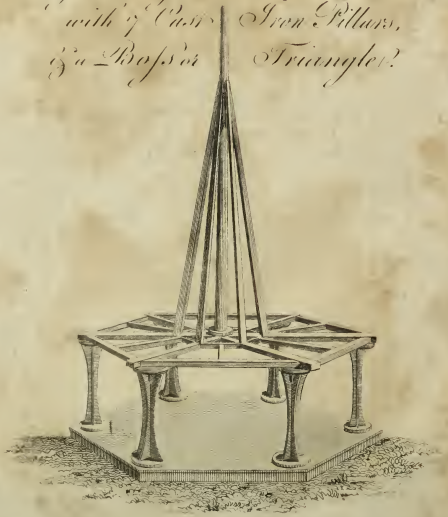
Engraving of a Corn Stack, with 7 Cast Iron Pillars, & a Boss or Triangle.





Engraving of a Corn Stand, with 7 Cast Iron Pillars, & a Boss or Triangle.



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Engraving of a Cradle Churn.

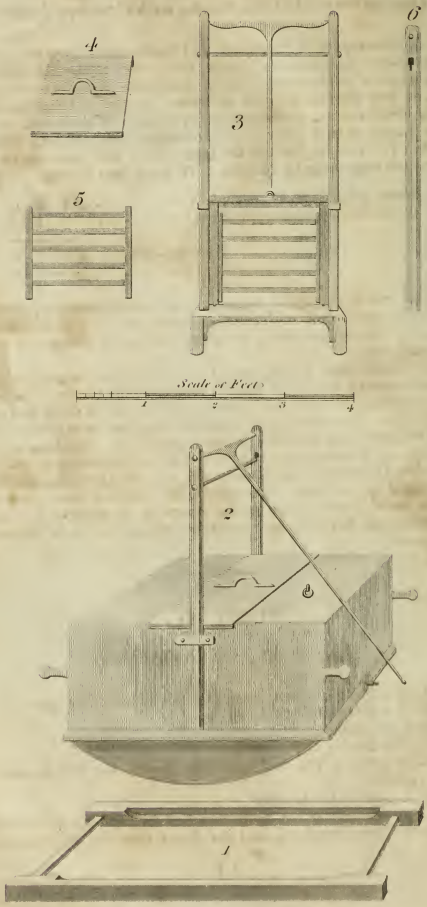

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PLATE III.

Description of the Corn-Stacks, with Cast-iron Pillars.

In the stack-yard at Shaw-park, in Clackmannanshire, there are 28 stacks placed on cast-metal pillars, three feet high. Each of these stacks contain 1584 sheaves, which, in all, would produce 728 Scotch bolls, or 539 English quarters of barley or oats; but that number of stacks, would contain a greater quantity of grain, if necessary.

The weight of each pillar should not exceed one half cwt., which at 16*s.* 4*d.* per cwt., is 8*s.* 2*d.* for each pillar; but they can be made lighter, and may easily be afforded at 7*s.* per pillar: hence,

Seven pillars, at 7*s.* each, ...	£2	9	0
Wood and workmanship, about	2	11	0
Total expence,	£5	0	0

In the first year, by an accurate experiment, comparing the same quantity of wheat, built on the ground, or on cast-iron pillars, the saving was 2*l.* 12*s.* 6*d.* per stack, and the whole expence would be repaid the second year.

If the pillars were higher, say 3½ or 4 feet high, the grain might be harvested sooner; but at the present height, wheat has been stacked in five days, beans in eight, and barley and oats in ten days, and sometimes earlier. No vermin can find their way into these stacks to consume the grain, and the straw is better preserved. The *boss*, or triangle, keeps up a circulation of air, and prevents heating, or other damage.—See General Report of Scotland, vol. iv. Appendix, p. 379.

In regard to the boss or triangle, a few spars of fir, or any other common wood, ought to be nailed across it, to prevent the sheaves from falling in; but if these cannot be got, a straw rope will answer the purpose.

PLATE IV.

Engraving of the Cradle Churn.

No. 1. Is a frame of wood, grooved inside of the edge.
No. 2. Is a perspective of the churn.
No. 3. Is a section of it.
No. 4. The lid.
No. 5. A grate in the centre, or two grates, ten inches apart, to slide in a groove.
No. 6. A post for the handle.

The churn should be not more than half full, and put on a wooden frame, rocked very regularly, and not faster than the pendulum of a clock.

PLATE V.

Description of a Wheel for raising Water.

In an account given of a mode of improving peat-bogs, by floating of the surface (See p. 174), it is stated, that much ingenuity was displayed, in constructing the machinery for that purpose. The whole depends upon a water wheel, the joint invention of Mr. George Meikle, and of his father, the celebrated inventor of the threshing-mill. The machine they constructed is so exceedingly simple, and acts in a manner so easy, natural, and uniform, that a common observer would be apt to under-value it; but persons skilled in mechanics, view machinery with a very different eye, for to them, simplicity is the first recommendation a machine can possess.

The better to explain the nature of this machine, two sketches are annexed, to the first of which, the following letters refer.

The explanation of the second will be found upon the sketch itself.

a, Sluice through which is admitted the water that moves the wheel.

b, b, Two sluices through which is admitted the water raised by the wheel.

c, c, A part of one of two wooden troughs, and an aperture in the wall, through which the above water is conveyed into the buckets. (The other trough is hid by two stone-walls that support the wheel).

d, d, d, Buckets, of which 80 are arranged on each side of the arms of the wheel = 160.

e, e, e, A cistern, into which the water, raised by the buckets, is discharged.

f, f, f, Wooden barrel-pipes, through which the water descends from the cistern under ground, to avoid the high road from Stirling, and the private approach to the house.

Sketch second, contains a plan of the cistern, and exhibits the manner in which the water is filled into the buckets.

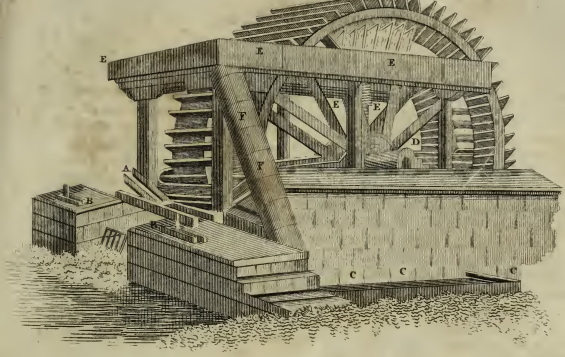
The diameter of the wheel, to the extremities of the floating-boards, is 28 feet; the length of the float-boards, 10 feet. The wheel makes nearly four revolutions per minute; in which time, it discharges into the cistern, 40 hogsheads of water. But this is not all the wheel is capable of performing, for by several accurate trials, by Messrs. Whitworth and Meikle, in the result of which, though made separately, they perfectly agreed, it was found that the wheel was able to lift no less a quantity than 60 hogsheads per minute; but that the diameter of the pipes, through which the water descends from the cistern, would not admit a greater quantity than what they already receive.

To a person at all conversant in hydraulics, the resemblance of this to the Persian wheel must be obvious; and indeed it is probable, that from the Persian wheel, the first idea of this machine was derived. But admitting this, still the superiority of the present wheel is, in most respects, so conspicuous, as to entitle it to little less praise than the first invention. For, 1*st*, in the Persian wheel, the buckets being all moveable, must be constantly going out of order; in this wheel they are all immoveable, consequently never can be out of order. 2*dly*, Instead of lifting the water from the bottom of the fall, as in the Persian wheel, this wheel lifts it from the top of the fall, being from four to five feet higher; by which means some additional power is

MOSS WATER WHEEL.

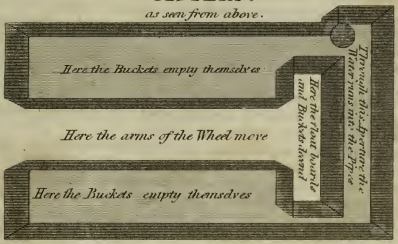
Used at Blair Drummond.

Plate 5.

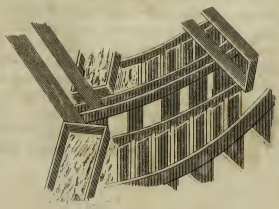


CISTERN.

as seen from above.



Manner in which the Water is filled from the Troughs into the Buckets.



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gained. *3dly*, By means of the three sluices, (*a* and *b*, fig. 1), in whatever situation the river may be, the quantity of the water to be raised, is so nicely adjusted to that of the moving power, as constantly to preserve the wheel in a steady and equable motion. In short, as a regulator to a watch, so are these sluices to this wheel, whose movements would otherwise be so various, as sometimes to carry the water clean over the cistern, sometimes to drop it entirely behind, but seldom so, as fully to discharge the whole contents of the buckets into the cistern.

It is, however, but candid to remark, that this machine labours under a small defect, which did not escape the observation of Mr. Whitworth; namely, that by raising the water about 3½ feet higher than the cistern, where it is ultimately delivered, a small degree of power is lost. To this indeed, he proposed a remedy; but candidly confessed, that, as it would render the machine somewhat more complex, and would also increase the friction, he thought it more advisable to keep it in its present state. At the same time, he justly observed, that as the stream by which the wheel is moved, is at all times copious and powerful, the small loss of power, occasioned by the above circumstances, was of little or no avail.

This stream is detached from the river Teith, at the place where it approaches nearest to the moss. The surface of the latter, is about 15 feet higher than that of the former; the cistern is therefore placed 17 feet above the surface of the stream, so as to leave a declivity sufficient to deliver the water upon the surface of the moss, consequently by this machinery, the water is raised 17 feet.

The pipes through which the water descends from the cistern, are composed of wooden barrels, hooped with iron, four feet long, and within, 18 inches in diameter.

In these pipes, having been conveyed underground for 354 yards from the cistern, the water at once emerges into an open aqueduct. This aqueduct, which was formed according to a plan by Mr. Whitworth, is constructed wholly of earth or clay; and in order to keep the water on a level with the surface of the moss, it is, for nearly two-thirds of its course, elevated from eight to ten feet above the level of the adjacent grounds; the base, being 40 feet broad, the summit 18 feet, and the water-course 10 feet broad. It commences at the termination of the pipes; from whence extending above 1400 yards, it discharges the water into a canal formed for its reception on the surface of the moss.

For raising the water to this height, there were two reasons. 1*st*, That not only where it was delivered on the moss, but even after being conveyed to the most distant corners, it might still retain sufficient power to transport the moss to the river Forth. *2dly*, That reservoirs of a sufficient height, might be formed in the moss, to retain the water delivered during night.

In consequence of Mr. Whitworth's advice, a contract was entered into with Mr. Meikle, in spring 1787; and by the end of October in that year, the wheel, pipes, and aqueduct, were all completely finished, and what, in so complex and extensive an undertaking, is by no means common, the different branches of the work, were so completely executed, and so happily adjusted to each other, that, upon trial, the effect answered the most sanguine expectations. The total expence, only a little exceeded one thousand pounds.—*Statistical Account of Scotland*, vol. ii. Appendix, p. 166.

PLATE VI.

Description of the Culture of Drilled Turnips in Scotland.

The advantages to be derived from drilling turnips, as practised in Scotland, and in the northern counties of England, have been already explained; (See p. 371). But as this is perhaps the completest operation that agriculture boasts of, it may be proper to give a more particular description of it, accompanied by an engraving, from an inspection of which, it will be more clearly understood*.

Fig. 1. Is a section of the drills, as first formed, and having the muck or dung spread out in the hollow drills, with a line, pointing out where the ridglets are afterwards split.

Fig. 2. Represents these drills, as split open, to cover the muck; what was formerly the hollow drills, is converted, by this operation, into the ridglets, and *vice versa.*

Fig. 3. Gives an idea of the figure of the drills or ridglets, after having been rolled by the drill-machine, at the time of sowing the seed. The seed cannot be sown too soon after the land is thus prepared for its reception.

Fig. 4. Is a representation of the appearance of the field, after the earth has been gathered into the intervals between the turnip drills, as formerly practised, but which has now given way to the use of the horse-hoe.

Fig. 5. Shews the situation of the drills, on finishing off the field, according to the old system, by splitting open the gathered ridglets in fig. 4, but which practice is not now generally followed.

Fig. 6. Gives an idea of the situation of a field of drilled turnips, as now generally finished off; the furrows, or hollow drills, not being opened out, the shave, or tops of the plants, being removed for the use of the young stock, previously to the feeding flock being laid on.

Fig. 7. Gives a plan upon a smaller scale than the preceding sections, of a turnip field in regular drills, in which the drills are laid off obliquely to the usual direction of the ridges, to facilitate the more equal distribution of the muck, which had been covered up in the drills, when afterwards ploughed for a crop of grain.

PLATE VII.

Engravings of an Improved Granary.

A particular description of this granary, is given in the Communications to the Board of Agriculture, vol. i. p. 53, and 54, of which the following is the substance.

Fig. 1. Is the front elevation. *A*, door into the lower part. *B*, door

* In they ear 1797, Mr. Alexander Low, an eminent land-surveyor, drew up, with great clearness and ability, a short account of the Berwickshire mode of turnip culture, for the late Duke of Bedford, which was the first complete description given of this superior practice.

Engravings of an Improved Granary.

Plate 7.

Fig. 1.

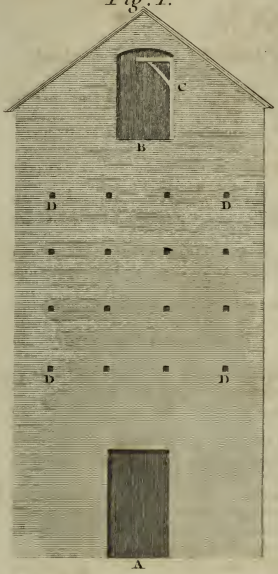

Fig. 2.

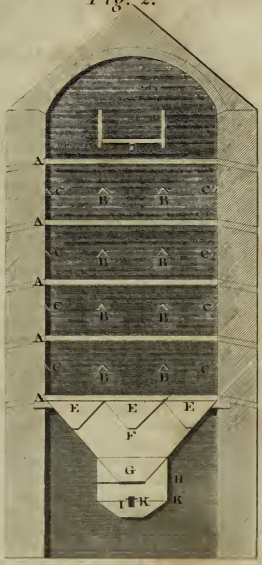

Fig. 3.

Fig. 4.

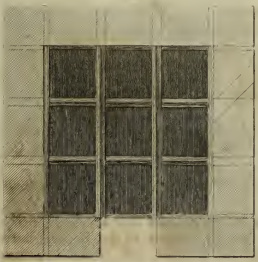

Fig. 5.

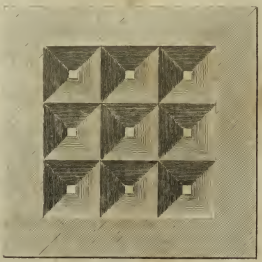

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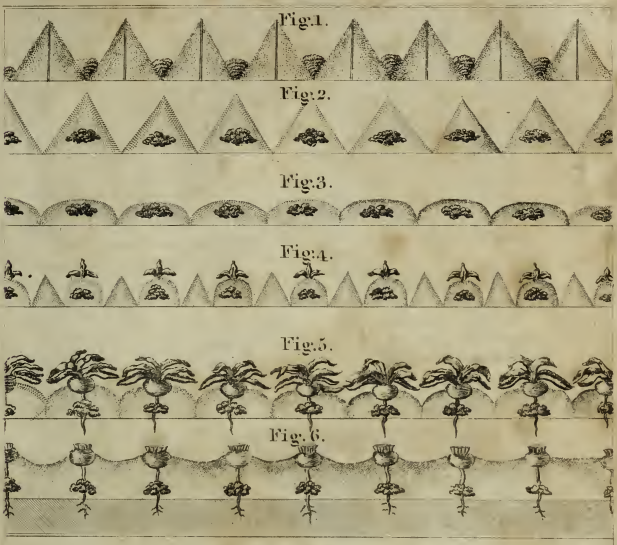
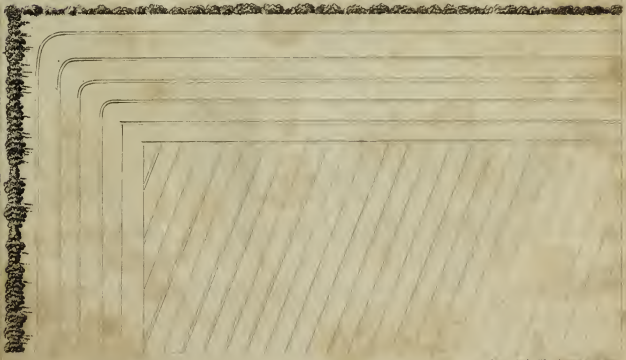
TABLE EXPLANATORY of the SCOTCH MODE of CULTIVATING TURNIPS in DRILLS.

Plate 6.



Scale of the Upper Figures 0 1 2 3 4 5 6 *Feet*

Fig:7. *The Scale one Quarter of the Upper Figures.*



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into the loft, to ascend to which, a ladder is necessary. *C*, a crane for hoisting sacks from below. *D*, d d d, air-holes.

Fig. 2. Is a section or view of the inside: a a a a a, are wooden spouts, which reach from the air-holes on one side of the granary, to those on the opposite side. These spouts are made of inch-deal, about six inches broad, and formed with an angle similar to those spouts that are sometimes used to carry off the rain water that drops from the easings of the houses. They are laid across the granary, with the angle uppermost, as shown in figure 3. B b b, are the ends of similar spouts, which cross the other ones, and reach also, between the air-holes, on the other two sides of the granary, as shewn in figure 4. C c c c, &c. are half spouts, extending in the same manner to air-holes on each side. The air-holes must have a declivity outwards, to prevent rain or snow beating in; and should likewise be secured with wire-cloth, to keep out insects and other vermin. D d, is the granary, which is three yards square, and divided each way into three hoppers. E e e, of one square yard each, making in all nine hoppers, as represented by figure 5. F, is a large hopper, which encompasses all the rest, and has a slider at G, for opening occasionally, when any grain is to be taken out.

There is also another small hopper J, suspended to the large one, by four iron hasps K k, and which may be easily unfastened, if required, from the square deal box *O o*, fixed to the large hopper. Through the side of this box, the handle H of the slider, must extend. This hopper is chiefly useful, for the convenience of taking out a small quantity, but is removed, when a large quantity is to be taken out of the granary*.

M, is a small loft, where the sacks of corn are hoisted up, and emptied over the sides or rails N n, from which it falls down, passes through the hopper *E e*, till *F* is filled (the slider being closed); and as the corn is continued to be emptied from the loft, so the granary continues to fill, till up to the top, if required.

The spouts being all inverted, as already mentioned, and open below, it is clear that, although the granary is filled to the top, the corn will not, like a fluid, rise within the spouts, above the level of their lower edges; and thus there will be a vacuum left within every spout, through which the air will freely pass. These spouts are placed, three feet distant from each other horizontally, from angle to angle, and eighteen inches vertically; that is, from those in one tier, to those of the next tier which crosses it.

The holes in the bottoms of the hoppers, *E e e*, &c. should be so proportioned, that one may not give vent to the grain faster than the other, for which reason, the aperture of the middle one, see *A*, fig. 5, should be the smallest, because there, the least obstruction will be found. The apertures *B b b b*, should be somewhat larger, as the grain will meet there, with some little obstruction, by the sides of the large hopper; and the apertures *C c c c*, should be the largest, as the obstruction in the angles, will be greater than in any other part.

On considering the plan of this granary, it is evident, than if filled with corn, and the slider *G* is opened, the whole mass will be moved, as the cornfalls out, consequently that a new surface will successively be exposed to the air that passes through the air-holes, and wooden spouts: and thus, by taking out a few bushels, perhaps at *G*, the whole

* This small hopper, seems rather unnecessary, and destroys the simplicity of the plan.

grain above, will be stirred, without any further trouble. The half spouts at the sides are very useful, for admitting air there also, and moving the grain, which might otherwise remain always close to the wall, which must be lined with deal or plank closely jointed.

Care must be taken, that the lower edges of the spouts, should be at least an inch lower than the bottom of the air-holes, that there may be no probability of their being interrupted.

It might perhaps be an improvement, to have a ventilator on the top of this granary, to make the current of air incline upwards, as well as through the spouts. It might also be another improvement, to have the spouts circular, and fixed to the air-holes, with small holes in them sufficient to circulate the air, but not to admit the grain. There might likewise be a screen for dressing the grain (if necessary), at the slider *G*. A conductor, or spout, might convey the grain, when dressed, into a sack, which might be wheeled to the outside of the granary, and hoisted up by the crane, to the loft *M*.

The principle of this granary, may be applied on any scale, from the corn chest in the stable, to the most extensive granary.

This plan is probably the most effectual, and the least expensive, of any hitherto suggested.

See Communications to the Board of Agriculture, vol. i. p. 53, 54, 55.

PLATE VIII.

Description of the Flemish Binot.

In the Appendix, p. 24, an account is given of an instrument, called in the Netherlands, the "*Binot*," which is found of the greatest utility in that country. It is also much approved of in the department of the North, and in the neighbourhood of Lisle, more especially for fallows, as it is found that the land elevated by the Binot, is more accessible to the beneficial effects of frost*. The form has been much improved since its introduction into this country, where such an implement will be found of great utility, in the cultivation and improvement of strong soils.

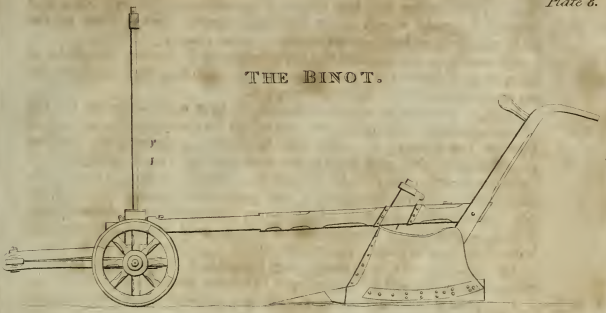
PLATE IX.

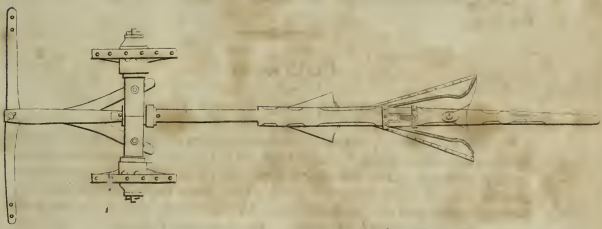
Description of the Barrow for Sowing Grain in Drills.

Fig. 1. Plan, or bird's-eye view of a drill-barrow.
2. Profile of the same implement.
3. End view of the same.
4. No. 1. an edge view of the seed-wheel. No. 2. Profile of the same wheel with flutes, or channels to receive the beans, and also a brush made of stiff bristles, placed above the wheel, to cause the seed to drop regularly into the bottom of the furrow.

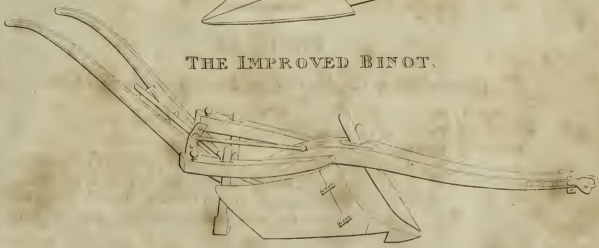
* See Statistique du Departement du Nord, par M. Dieudonnée, *prefet*. Printed at Douai, an. 1804, vol. i. p. 363.

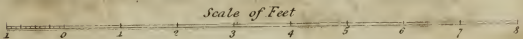
THE BINOT.





THE IMPROVED BINOT.





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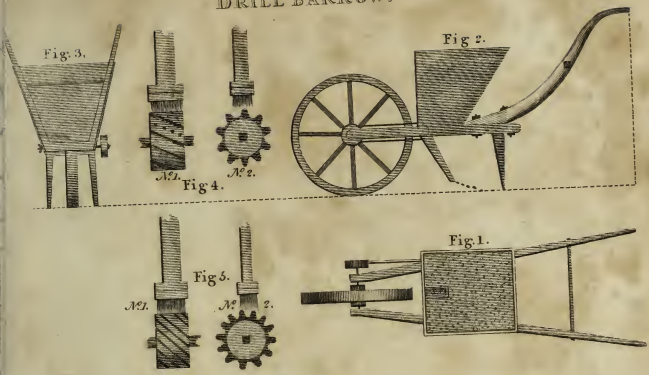
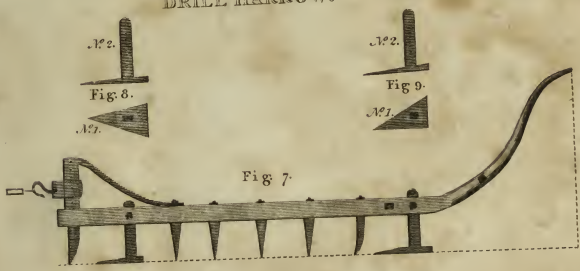
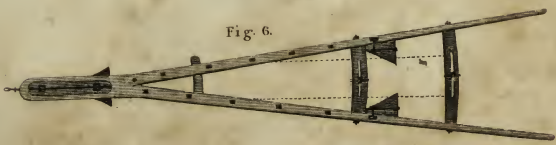
DRILL BARROW.



DRILL HARROW.





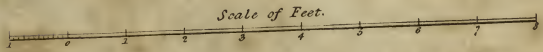


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Fig. 5. No. 1. and 2. Seed wheel for sowing oats, barley, wheat, and pease. Either of these wheels may be easily placed upon the axle, or taken off at pleasure, according to the sort of grain to be sown.

Description of the Drill-Harrow.

Fig. 6. Plan of a harrow for cutting weeds and pulverising the soil betwixt the drills.

7. Profile of the same machine.

8. No. 1. and 2. Plan and profile of the front share.

9. No. 1. and 2. Plan and profile of one of the hindmost shares, which shares may be easily shifted and fixed at a greater or lesser distance from each other, according to the distance between the drills, which is shown by the figure.

Finis.

B. M'Millan, Printer,
Bow-Street, Covent-Garden.

DIRECTIONS TO THE BINDER,

FOR PLACING THE PLATES.

☞ *Note.*—The Folios referred to are those of the Appendix.

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